SCIENCE

NOT ANTAGONISTIC TO SCRIPTURE

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SCIENCE ELUCIDATIVE OF SCRIPTURE

AND NOT ANTAGONISTIC TO IT

BEING A SERIES OF ESSAYS ON

I. ALLEGED DISCREPANCIES
II. THE THEORIES OF THE GEOLOGISTS AND FIGURE OF THE EARTH
III. THE MOSAIC COSMOGONY
IV. MIRACLES IN GENERAL—VIEWS OF HUME AND POWELL
V. { THE MIRACLE OF JOSHUA—VIEWS OF DR. COLENSO
  { THE SUPERNATURALLY IMPOSSIBLE
VI. THE AGE OF THE FIXED STARS—THEIR DISTANCES AND MASSES

BY

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PREFACE.

SO full an account of the subjects to be discussed in the following pages is given in the INTRODUCTION, that there is no necessity to even enumerate them here. Now that the book is completed, I think I may say that what was promised in that preliminary notice has been pretty literally fulfilled. I have never indulged in exhortation or persuasion, but have left the declarations of Scripture, in so far as they have been assailed by science, in certain recent publications, to be also vindicated by science.

I am fully sensible of my own incompetency to do complete justice to the cause I have undertaken; and am well aware that other and abler pens have been employed in its advocacy and defence. But I am a layman, and the writers alluded to are clergymen. And although this difference of position of the writers ought, in

justice, to make none in the judgment pronounced on their writings, yet with many, prejudice will have an influence; and when attacks on the Bible are to be repelled, it is likely that a volunteer in the service may receive from such persons a more willing and candid attention than they would give to one whose sacred office and bounden duty it avowedly is, to 'drive away all erroneous and strange doctrines contrary to God's word.'*

Besides, books intended to accomplish the purposes that this book aims at, are not likely to become too numerous. Assailants of Scripture are multiplying: they are starting up in the most unlooked-for directions, deserting even the banners under which their names have been enrolled, and enlisting in the opposite ranks. And whatever be the subject of contention, the interests of truth are sometimes promoted when a person who might be excused for standing aloof from the contest, spontaneously comes forward, and respectfully submits the results of his own independent reflections on the matters in dispute. This independence of thought I can truthfully claim. There will be found in this book little or no evidence of research into the views and

* Ordination Service for Priests.

opinions of others: no doubt much that I have here advanced will be discovered, upon examination, to have been said, and perhaps better said, before; but I have received no aid from sources which I have not expressly acknowledged; and my obligations will not, I think, be considered to have been very extensive.

So much, by way of apology, for abandoning my ordinary pursuits for a time, to engage in a controversy having but a remote connection with them. I shall avail myself of the opportunity which this Preface furnishes to advert now to another topic.

All but about the last two sheets of this book was in the printers' hands, when the remarkable *Examination of the Pentateuch* by the Bishop of Natal made its appearance. I procured it immediately, but found, to my great disappointment, that all that had hitherto been alleged to be scientific difficulties in the Mosaic history were left entirely unnoticed. Upon the earlier chapters of Genesis nothing whatever is said. I found, however, some futile, and, I think, very ridiculous objections to the miracle of Joshua; and as I was just at the time considering that remarkable occurrence, the opportunity was

afforded me of showing them to be such. (See Section V.)

Every one who reads the preface to Dr. Colenso's book, must be struck with amazement that the author's candour should so far have exceeded his prudence and discretion as to have led him to the discreditable acknowledgement that he, a *bishop*, should, for the first time, have had his thoughts seriously directed to 'the story of the flood' by a Zulu Kaffir; that the disciple should have found his master, whose bounden *professional* duty it was to have well studied the Bible, as unprepared in one of the most noticeable events recorded in that Bible, as he, poor heathen, was himself.

In so far as I have examined his book, Dr. Colenso's critical objections seem to be much on a par with those considered in the following pages; that is, they assume the events of the Bible to be like the events of ordinary history, all of which that are not referable to human agencies and physical laws must be rejected as 'unhistorical.' Thus, in illustration of the impossibility of 'the march out of Israel,' as recorded in Exodus, he says, 'We have this vast body of people of all ages, summoned to start, according to the story, at a moment's notice,

and actually started, not one being left behind, together with all their multitudinous flocks and herds, which must have spread out over a district as large as a good-sized English county. Remembering, as I do, the confusion in my own household of thirty or forty persons, when once we were obliged to fly at dead of night—having been roused from our beds with a false alarm, that an invading Zulu force had entered the colony, had evaded the English troops sent to meet them, and was making its way direct for our station, killing right and left as it came along—I do not hesitate to declare this statement to be utterly incredible and impossible.'

A strange ground, truly, for declaring the flight out of Egypt 'to be utterly incredible and impossible'! How is it that the right reverend author did not for a moment reflect that *his* people were not led by JEHOVAH, nor the people of Israel by the *Bishop of Natal*?

Although, as I have said above, and as this quotation sufficiently proves, Dr. Colenso looks for a natural or physical explanation for every supernatural event, yet I see that the bulk of his book is occupied with petty arithmetical calculations and criticisms. The Bible has often had formidable antagonists to deal with. The

artillery levelled against it has hitherto been brought from the richly-furnished arsenals of learning and research; and whatever may have been thought of the assailants, respect has always been felt for the dignity of their weapons. But has it at length come to this? Has the Bible fallen so low, that its defenders must now enter the arena, not against the science of *men*, but against the science of *schoolboys*? Is it possible that the time has arrived when the Bible is to be dragged before the meanest of tribunals, and there arraigned, on the contemptible and humiliating charge, that — 'it is not according to COCKER'?

J. R. Y.

December 24, 1862.

CONTENTS.

INTRODUCTORY REMARKS.

THE object of the following pages is to discuss fairly and honestly the several objections which science has been recently alleged to oppose to certain doctrines of scripture, more especially to those revealed to us in the Mosaic account of the creation.

I have been tempted to this discussion by the wide circulation of the *Essays and Reviews*, in which work, I think, that both science and scripture have, in many instances, been equally misrepresented.

A considerable portion of that volume, however, is devoted to matters exclusively connected with our ecclesiastical economy, and to inquiries upon subjects of philology and biblical criticism. With these I have not presumed to meddle; they have already been sufficiently disposed of by competent scholars and divines.*

* In *Replies to Essays and Reviews*, and in *Aids to Faith*.

I shall confine myself in this book almost entirely to those purely scientific difficulties which have been affirmed to oppose serious objections to the general trustworthiness, and consequently as serious obstacles to the unhesitating reception, of certain portions of the Bible regarded as an inspired Book; and I hope to show that these difficulties have been very unduly exaggerated, —that, in fact, they entirely disappear, when examined by the light of science in a fair and candid spirit.

The title I propose to give to the present volume, I adopt less from choice than from necessity. The extent of scientific knowledge and research which is required for a discussion of this kind is but very moderate; it is, in fact, little more than rudimentary. But the objections to scripture which I have to consider in the following pages are put forward as objections which 'modern science' endorses: my purpose is to show that modern science does no such thing; but that, on the contrary, it diffuses light rather than darkness over the sacred page. I had to choose a title significant of this truth.

The subjects to be considered will be separated into six heads or sections. In the first of these I shall briefly examine one or two of the more popular of the alleged discrepancies between

science and revelation, and shall have to revert to the thread-bare controversy concerning Galileo and the motion of the earth, since one of the Essayists, in alluding to that melancholy affair, subscribes to the verdict of the Inquisition, and pronounces Galileo's astronomical doctrine to be contrary to scripture. The same writer opposes certain of the Bible statements of a much more serious and important character, and on grounds which he affirms to have the countenance and authority of modern science: these grounds will be investigated in the third section; but his unscriptural deductions from a few figurative forms of expression employed by the inspired writers, I shall notice in the present section, and shall, I think, have little difficulty in showing that they are not only unscriptural, but illogical.

The second section will probably extend to much greater length. It will be devoted to an inquiry into the original condition and present figure of the earth, and will contain a review of some prevailing and favourite theories of the geologists. I shall differ from them in these theories, not on scriptural but on scientific grounds, although I think that scripture can suggest a modification of their views which deserves their attention. I do not, however, consider that science is amenable to any tribunal

but its own : an appeal to any other authority is both unwise and unfair, and, except under coercion, and then only for a time, is sure to prove of no avail.

But the case is different when, behind the shield of so-called science, the gauntlet is openly and publicly thrown down in defiance of the Bible. The challenge cannot be declined—it *must* be accepted; and people who would never think of seeking science in revelation, any more than they would look for revelation in science, feel themselves constrained, as a duty they owe both to one and the other, to examine more closely than they otherwise would do into the pretensions of the aggressor, in reference to his offensive apparatus, and to ascertain whether the power to inflict injury equals the desire.

One of the ablest and most distinguished of the writers in the *Essays and Reviews*, in a previously published work, delivers himself thus : —

'In a former essay I have adverted to the question of the discrepancies between science and the language of scripture generally, and have referred more especially to that notable instance of it—the irreconcileable contradiction between the whole view opened up to us by geology and the narrative of the creation in the Hebrew scriptures, whether as briefly delivered from Sinai, or as expounded in Genesis. In the minds

of all *competently informed persons* at the present day, after a long struggle for existence, the literal belief in the Judaical Cosmogony, it may now be said, has died a natural death. . . . Those who accept geological truths at all, and admit the palpable contradiction to the Old Testament, without prejudice to their faith, cannot with *consistency* make it a ground of objection to any hypothesis of the *nature* of the changes indicated, that they are *contrary to scripture.* They are in no way *more so* than *all geology* is.' (Professor Powell's *Essay on the Philosophy of Creation.*)*

The publication of such sentiments as these is, to say the least, very injudicious. So long as geology lets the Bible alone, it may go on constructing its theories as it pleases; but if these theories are paraded in opposition to scripture, as 'geological *truths*,' the grounds upon which they lay claim to this dignity must be examined.

Everybody knows that physical hypotheses are by no means necessarily physical truths, even in the estimation of those who originate them. Hypotheses are *invented* to group together natural phenomena under some assumed general principle from which those phenomena may be logically deduced. As observation extends, the hypothesis

* I take this quotation from Archdeacon Pratt's interesting work, *Scripture and Science not at Variance.* I have not as yet seen the book from which it is extracted.

frequently requires modification or enlargement, to bring the new appearances within its expression; and not *un*frequently it has to be abandoned altogether. The recent discovery of the planet Neptune, for instance, led to the abandonment of *Bode's Law of the Planetary Distances*, as it was called; since the hypothesis so named did not, and could not include the phenomena, as to distance, furnished by the new case. In a similar manner, the hypothesis of Laplace, in reference to the physical cause of the planetary motions, fails in the single case of the satellites of Uranus, and is therefore no longer tenable, even as an hypothesis.

But of all the physical sciences, theoretical geology is that which is the least entitled to assume a tone of arrogance, and fling its defiance in the face of 'the Old Testament;' for, whatever be 'the palpable contradictions' between geology and this Book, they cannot be more glaring than those which geology supplies against itself.

In this second section a few pages will be devoted to an estimate of the real pretensions of this formidable opponent of the Bible. But in addition to showing that these are greatly below the vaunted pretensions, I shall be able to do little more than to offer what appear to me to be reasonable suggestions for a sounder geological theory. The carrying out of these, if they are

at all worthy of being entertained, I must leave to more competent inquirers, in the hope and expectation that, after all, the mighty champion thus put forward, on the part of geology, may eventually prove to be only another 'Philistine of Gath.'

The third section will be occupied with an examination of the first chapter of Genesis, chiefly with the view to meet the charge promulgated in the *Essays and Reviews*, that the Mosaic account of the creation is 'adverse to modern science.'

This section is to be regarded as the third edition, very much enlarged, of a pamphlet I published several months ago, on 'The Mosaic Cosmogony.' The very favourable reception which that hastily written tract met with, as well from private individuals of eminence as from the public press generally, has encouraged me to give to the subject a more deliberate consideration. I have examined the repudiated texts in detail, and think I shall be able to prove that the charge referred to is entirely groundless. Modern *conjecture* may, indeed, put on an attitude of opposition to the Divine record, but modern *science* (not 'science falsely so called') disclaims the allegation. It will be necessary, in establishing this assertion, to advert again to the geological theories, and perhaps to dwell upon

what I regard as the *scriptural* geology somewhat more at length. I use this epithet, because I think that Moses's authoritative declaration as to the original condition of the earth is *scientifically* preferable to that of modern geologists, which is that the earth was originally a seething globe of molten matter.

There is one interesting question connected with the subject of this section which I must leave in abeyance. It is this: Were the fixed stars created at any time during the 'six days,' or were they already in existence anterior to the Adamite period? Scripture furnishes us with no data on which to base any certain conclusions as to the age of the fixed stars; nor, indeed, does science. Science may possibly hereafter throw more light upon this obscure question than it has, as yet, been able to do; and if so, we shall then know more as to *when* 'He made the stars also.' As regards scripture, the inquiry is merely one of enlightened curiosity; the successful result of it would be of consequence solely in a scientific point of view. We should like to know, indeed, on sufficient grounds, whether the fixed stars were in existence ages before Adam or not; though the integrity of the Mosaic narrative will remain just the same, in whichever way the point be settled. I intend, therefore, in the observations upon this subject in the present

section, to proceed on the *hypothesis* that the stars were supplied during the creative week; and shall postpone the consideration of the other view till the sixth and last section. And it is as well to forewarn the reader here of this intended arrangement.

The next section will treat of miracles in general, and will be devoted principally to a refutation of the unphilosophical opinions which have frequently been broached respecting these special manifestions of Divine Power, more particularly of those advanced by the late Professor Powell.

As physical science is concerned exclusively with the phenomena of what is called material *nature*, one would think that it could have nothing to say respecting supernatural phenomena, either for or against. The writer just mentioned, however, has so managed to connect and confuse these two entirely distinct classes of occurrences, as to render it necessary, in an examination of his views and assertions, to dissolve the heterogeneous union, and to restore each to its proper place.

It is no doubt true that a knowledge of physical science may sometimes qualify us to define more clearly to our own minds the extent to which miraculous power operated in the bringing

about a witnessed result—to discriminate between the supernatural and the natural, but it can do nothing more, and nothing more will be claimed for it in the following pages; but the essayist claims for physical science a great deal besides this, in fact, the supernatural as well as the natural — including both under this latter term.

Mr. Powell insists that no operations can take place in the natural world that are not nature's own, and consequently that all real phenomena hitherto addressed to the senses of man, from the *creation* of nature till now, must have been natural phenomena; that the so-called miracles were either pure delusions, which the honest but deceived victims of them took for realities, or else they were real phenomena, capable of being understood and explained upon strictly physical principles.

It will be the business of this fourth section to show the untenableness of these positions; and I think it will be satisfactorily proved, that even the admission of them altogether fails to establish what the author avowedly aims at, namely, that a miracle is both impossible and inconceivable; in fact, that on the contrary, they tend to the very opposite conclusion. In the course of this section I shall have occasionally to advert to the more philosophical notions of Hume on this subject, and shall append a Note at the end, in

which the more tangible hypothesis, touching the incredibility of miracles, advocated by this celebrated sceptic, is submitted to strict mathematical examination.

To the special miracle recorded in the book of Joshua, a separate consideration will be given. I shall attempt an explanation as to what the miraculous performances really were, or might have been, without adopting the hypothesis of any interference with the motion of the earth. By arresting this motion — the rotatory motion merely, and the orbital revolution of the moon — the phenomena recorded would, of course, have presented themselves; but I think they may have been brought about in a much simpler manner, and this the physical objections, which have been sometimes advanced, be overruled and rendered nugatory. Not that I regard these objections as of any real weight; for I suppose that the power which moved the earth can stop it; and as to the frivolous opposition to this, on the ground that if the motion of the earth were arrested, everything upon it would be destroyed, it is too ridiculous to deserve serious attention. It is virtually assuming that the earth was stopped *by accident.*

It is to the discussion of this subject that a portion of the fifth section will be devoted; the

remaining portion will be occupied in considering the *supernaturally impossible.* To some readers this term may appear to be objectionable, and even irreverent; but I think I shall be able to show that there is strict propriety in it, and that it is profitable to have our attention directed to matters of this kind. Very serious mistakes have been committed, from taking the perfectly true proposition, 'All things are possible with God,' without the necessary limitation: self-contradictory acts or events are evidently not included among the 'all things' here indicated. I shall show that the Roman Catholic doctrine of transubstantiation is one of these self-contradictory events; and shall prove, by what I think will be regarded as sound reasoning, that it is supernaturally impossible. I do not go out of my way in adverting to this often-discussed topic. It comes fairly before me in connection with the general subject of miracles, and I think that a doctrine which has been repeatedly called in question with so much acrimony, it is much better to examine upon logical principles, than to appeal, for or against, to tradition—to the theological teachings of ancient fathers of the Church, or to the decrees of popes and councils.

The sixth and last section will be wholly occupied with the subject of the fixed stars—their

supposed distances, and supposed masses. The inquiry is more closely connected with the main purpose of this book than may at first sight appear; and the reader is requested to regard it as an addendum or supplement to what is delivered in the third section. The alleged utter insignificance of this earth, and, indeed, of the entire solar system, in comparison with the glorious objects with which 'He hath garnished the heavens,'* has been dwelt upon as if 'our own humble globe' were too contemptible a thing for its Creator's notice; and yet, inconsistently enough, it is affirmed by the writer who thus disparages it, as having been worthy of no fewer than nine-and-twenty distinct renewals—as having been the theatre of so many different creations of animated beings!

But whether the earth be small or large, in comparison with the remote bodies of the starry heavens, is a matter of not the slightest moment. Value and excellence are not, even with us, estimated by magnitude; and no one would think of bringing into comparison, with a view to such estimation, the Koh-i-noor diamond and a block of granite.

It was my original intention to have closed the present volume with some remarks on the nebular

* Job xxvi. 13.

hypothesis of Laplace, briefly adverted to at p. 6 of this introduction, chiefly because a good deal of importance has been attributed to it of late; but I have resolved to abandon this intention, merely observing here, that if Laplace had been now living, there is little doubt that he himself would have pronounced it to be untenable. The motions of the satellites of Uranus, as already noticed, are quite incompatible with his ingenious theory: they move in a way in every respect directly contrary to what the hypothesis requires. But that illustrious mathematician never regarded his scheme as anything more than a mere conjecture as to the physical cause or causes of the observed planetary motions, although some recent writers, with much injustice to its author, have referred to it as if delivered by him as a scientific doctrine. He himself says he offers it with that *distrust* which ought to inspire everything which is not the result of observation or calculation. I quote his words in the foot-note below.* In his great *scientific* work, the *Mécanique Céleste*, the author never makes the slightest allusion to the nebular hypothesis.

* 'Quelle est cette cause primitive? J'exposerai sur cela, dans la note qui termine cet ouvrage, une hypothèse qui me paraît résulter, avec une grande vraisemblance, des phénomènes précédents, mais que je présente avec la défiance que doit inspirer tout ce qui n'est point un résultat de l'observation ou du calcul.' — *Système du Monde*, cinquième édition, p. 390.

The foregoing enumeration of the principal topics to be discussed in the following pages will, in some measure, prepare the reader for what he is to expect. I have only to enjoin him to give the book a candid and dispassionate perusal, and then form his own conclusions as to whether or not science is really adverse to the scriptural records. I here merely submit to him the arguments and considerations which have abundantly satisfied my own mind, and I have earnestly endeavoured to check in myself all undue bias, one way or the other.

As to the counsel proffered in the *Essays and Reviews*, namely, to examine into the veracity and authenticity of the Bible with the same cool indifference that we would sit down to criticise any other book — to sustain, in this examination, the character of the unbiassed judge, and not that of the advocate or partisan, I think it is not practicable, strictly, to follow it. The Bible is a book which too deeply concerns man's temporal and eternal welfare to be read with the same indifference, as to its truth or falsehood, with which we might read a work in which we had not the slightest personal interest. But, in so far as I can do so, I shall adhere to this principle throughout the following pages. At all events, I shall never knowingly strain or distort any scientific truth, or any scriptural text, for the

purpose of forcing a seeming agreement between the two. I believe that in what follows I shall in no case have to resist any such temptation.

The reader, however, will not expect that I presume to explain in these pages how the Creator, step after step, constructed the universe; or how He wrought His miracles. My task is simply this: to prove, *on its own principles*, that SCIENCE is *not* antagonistic to SCRIPTURE; that the opposition between them that has been recently alleged has been wrongfully alleged, and that in every one of the instances adduced in support of these allegations, science, so far from opposing, will be found, on careful and candid examination, to be elucidative of scripture.

SCIENCE ELUCIDATIVE OF SCRIPTURE.

SECTION I.

ON CERTAIN ALLEGED DISCREPANCIES BETWEEN SCIENCE AND SCRIPTURE.

IT is principally in the first few pages of the Bible, and in a passage or two of Job and the Psalms, that men have imagined, from time to time, that they find a discordance between the statements of Revelation and the truths of physical science. Such fancied discrepancies deserve careful and impartial examination. Contradictory conclusions can never both be true; and, where they refer to matters of the highest importance, it is incumbent upon every one to be convinced in his own mind which of the two ought to be admitted, and which rejected.

The manifest object of the Book of Genesis is to reveal to man his own origin and early history;

to impress upon him what, by the unaided exercise of his own intellect, he could never have discovered for himself, namely, that he, the earth on which he treads, the starry glories by which he is surrounded, and all that we now call the 'wonders of nature,' were so many creations of but One Supreme Being; and thus to preclude alike the notion of Atheism on the one hand, and of Polytheism on the other.

That this, and this alone, is the end in view, the narrative itself sufficiently proves by its own internal evidence. There is a uniform and (so to speak) a studied avoidance of all reference to matters calculated to divert the mind from these authoritative declarations, and to turn its thoughts into the channel of philosophical speculation. The first chapter of Genesis is occupied exclusively with the great fundamental truths of theology—truths which physical science could never have arrived at, and with which physical science has, in fact, nothing to do. It inaugurates, not a Principia, but THE BIBLE.

The following observations of a recent writer, in reference to what might be called (though in self-contradictory terms) scientific revelation, or revealed science, are worthy of quotation:—

'It is no business of the Bible, we are told, to teach science. Certainly not; but that is far too little. It is an obligation resting upon the Bible,

if it is to be consistent with itself, that it should *refuse* to teach science; and if the Bible ever *had* taught any one art, science, or process of life, capital doubts would have clouded our confidence in the authority of the book. By what caprice, it would have been asked, is a divine mission abandoned suddenly for a human mission? By what caprice is this one science taught, and others not? or these two, suppose, and not all? But an objection even deadlier would have followed. It is clear, as the purpose of daylight, that the whole body of the arts and sciences composes one vast machinery for the irritation and developement of the human intellect. For this end they exist. To see God, therefore, descending into the arena of science, and contending, as it were, for His own prizes, by teaching science in the Bible, would be to see Him intercepting, from their self-evident destination (viz. man's intellectual benefit), His own problems, by solving them Himself. No spectacle could more dishonour the divine idea—could more injure man, under the mask of aiding him. *The Bible must not teach anything that man can teach himself.** Does a doctrine require

* This assertion, which the author puts in italics, *appears* to be a little too unqualified. The passage of Job, for instance, 'He hangeth the earth upon nothing,' is an authoritative statement of the Bible; but science arrived at the fact independently. Yet the Bible does not *teach* it, it *declares* it.

a revelation?—then nobody but God *can* teach it. Does it require none?—then, in whatever case God has qualified man to do a thing for himself, He has, in that very qualification, silently laid an injunction upon man to do it.'*

But although it would be as inconsistent with the declared purpose of scripture, as it would be derogatory to its exalted province, to teach the principles of physical science, yet it instructs us as to the origin and chronological order, of the creation of the more striking and magnificent objects with which physical science has to deal, making more especial reference to the earth we inhabit. These, however, are not scientific disclosures, but divine revelations, enlightening us as to *what* God has done, and as to the order in which the parts of the mighty mechanism succeeded one another. But as to *how* the work was accomplished, revelation is silent: it could not be otherwise. Constituted as he is, man is absolutely incapable of instruction in such matters, and even a divine communication would fail to reach his understanding: the *creative* operations of a Deity none but a Deity can comprehend. Indeed, the term *operations*, in reference to creative acts, is itself unintelligible and unmeaning.

Man's privilege and power are limited to the

* De Quincey's works, vol. vii. p. 132.

contemplation of the completed machinery, the movements of which he may be enabled to trace, and their design and purpose to understand; but how the parts were brought together, or how the movements he witnesses were originally impressed, it is not given him to know. The most exalted and the most laudable exercise of his intellect is to employ it to the utmost for the special purposes for which it must have been bestowed—the purposes, namely, of learning all he can of the power and wisdom of God, as displayed in the finished works He has spread around him. In prosecuting these researches, however, it is possible to happen — and occasionally it does happen, either from an erroneous impression of some phenomenon in the natural world, or from a mistaken interpretation of some text of scripture, delivering an authoritative announcement touching that phenomenon — that science and revelation appear to come into collision. The most memorable instance of such an apparent collision is connected with the scientific truth of the motion of the earth. Galileo maintained, and justly so, that the earth moved. This doctrine *the Church* pronounced to be unscriptural and heretical; and, strange to say, there are some, even at the present day, who openly endorse these views, not however for the purpose of impugning science, but scripture. We say this is strange; for it was scarcely to be expected that,

out of the pale of the Romish Church, any one could be found who would regard the verdict of ecclesiastics, of whatever creed, as necessarily the verdict of revelation.

Now, the most remarkable feature in the whole of the disgraceful proceedings of the Church against Galileo is, that *ecclesiastical infallibility* should have *failed* correctly to expound a text of scripture. The Bible nowhere affirms that 'the earth does not move,' or that 'the earth cannot move;' what it does affirm is, that *the earth cannot* BE *moved*: — a very different declaration. If we say of anything, 'it is moving,' we merely enunciate the simple fact of its motion; the idea of *coercion* is absent: but if we say of it, 'it is being moved,' that idea is necessarily present. Hence, all that the text, 'The world is established, it cannot be moved,' fairly implies is, that its condition is determined — beyond the reach of chance, casualty, or accident — by the Creator. HE, of course, if He so please, can disturb this condition; but we think that no one will find fault with the inspired writer for not introducing so very unnecessary a qualification. What is obviously meant is, that neither human contrivances nor the existing laws of nature can *coercively* operate on the earth, so as at any time to move it from its pre-established position. The sense, in fact, is the same as that in which we now use the terms — 'as

immovable as a rock,' notwithstanding we well know that its actual position in space is changing every instant. But who could dispute the propriety, or even the strict accuracy of the statement — in reference, for instance, to Teneriffe, or the island of St. Helena — 'the rock is fixed: it cannot be moved'? * This is very different from saying, 'the rock is fixed: it cannot move.'

But the writer of the Essay on the 'Mosaic Cosmogony' does not see this; but, on the contrary, is quite at one with the Church of Rome in the controversy: he says, 'The Church naturally took a lively interest in the dispute which arose between the philosophers of the new school and those who adhered to the old doctrines, inasmuch as the Hebrew records, the basis of religious faith, *manifestly countenanced the opinion of the earth's immobility*, and certain other views of the universe very incompatible with those propounded by Copernicus. Hence arose the official proceedings against Galileo, in consequence of which he submitted to sign his celebrated recantation. . . . The solution of the difficulty, offered by Galileo and others, was that the object of revelation, or divine unveiling of mysteries, must be to teach man things which he is unable, and ever must remain

* That is, uprooted—overset—displaced, at any instant from its prescribed or destined position in space at that instant.

unable to find out for himself; but not physical truths, for the discovery of which he has faculties specially provided by his Creator. Hence, it was not unreasonable, that in regard to matters of fact merely, the sacred writings should use the common language, and assume the common belief of mankind [Query: The common belief of mankind *at what period*?] without purporting to correct errors upon points morally indifferent. So in regard to such a text as "The world is established, it cannot be moved," *though it might imply the sacred penman's ignorance of the fact that the earth does move*, yet it does not put forth this opinion as an indispensable point of faith.' (*Essays and Reviews*, third edition, pp. 207–8.)

In juxtaposition with what Mr. Goodwin here says about 'the *sacred* penman's ignorance,' in reference to the stability of the earth, may be placed what a *scientific* penman (whose superior knowledge of such matters Mr. Goodwin will be the first to admit) says, not only of the stability of the earth, but of the solar system generally, though the whole of it is in motion: 'The simple but *grand truth* of the law of conservation, and STABILITY of the heavenly motions, now well understood by all sound cosmical philosophers,' &c. (Prof. Powell in *Essays and Reviews*, p. 134.) Is not this '*grand truth*' a full justification of the very language of the text? The greatest achieve-

ment of Lagrange was the demonstration of the stability of the entire solar system.

Instead of the case of Galileo being adverted to as a proof of the antagonism between scripture and science, it ought to be adverted to as *conclusive evidence against the infallibility of the Romish Church.* And that Church is even now in this predicament: it must either still *deny* the motion of the earth, or it must *admit* that, in the matter of scriptural interpretation, it is not infallible. It seems to prefer the former alternative; for to the last of the Jesuits' edition of Newton's *Principia,* there is prefixed the following cautionary notice: —

'Newton, in his third book, adopts the hypothesis of the motion of the earth. We could not explain his propositions without making the same hypothesis. Hence, we are compelled to assume a character different from our own, for we profess obedience to the decrees promulgated by the Popes against the motion of the earth.' (Translated from the last edition (1823) of the *Principia,* edited by the learned Jesuits, Le Sueur and Jacquier.)

The text in question neither affirms nor denies anything about the motion of the earth: this is a matter on which science is competent to decide, and accordingly to science it is wisely left to pronounce for or against. Suppose the declaration

had been 'The earth is established in all its movements:' what would the scientific predecessors of Galileo and Copernicus have thought of this implied opposition to *their* science, maintaining, as it did, that the earth was at rest? Is it not wiser and better—better for the purposes of scripture, and better for the interests of science, that when allusion is made in the former to matters which, only after ages of speculation and error, the latter is able to clearly expound, and enrol among its physical truths—is it not better that such allusion should be in terms of reservation, in terms of obscurity—nay, even in terms of ambiguity, rather than that revelation, which is equally designed for *all* ages, should be received and rejected, and received again, and so on, alternately, according as scientific truth or scientific error prevails with mankind?

It is derogatory to the wisdom of the Deity to imagine that He would communicate a divine message to man exclusively for his spiritual and eternal interests, and yet make its reception dependent upon the fluctuations of philosophical opinion, or so word any part of it that its credibility must be contingent upon the admission or rejection of some doubtful point of physical astronomy. Such points are very wisely left for man himself to settle. If the Bible does not *teach* science, as little does it *oppose* it. 'Physical

science,' says Mr. Goodwin, 'goes on unconcernedly pursuing its own paths.' So it ought to do; and as the attempt should be condemned either to coax scripture into agreement with science, or science into agreement with scripture, so, surely, should the attempt be equally condemned to strain either into *disagreement* with the other. In the case of the motion of the earth, the alleged disagreement with scripture arose from no determined hostility to science; but from the honest conviction, of poor human fallibility, that a declaration in the Bible was something different from what it really is. It is certainly remarkable that so sad a mistake should have been committed—and, in fact, so *glaring* a mistake, by men whose special function it was to make themselves well acquainted with the language and phraseology of the Book; for according to their mode of interpreting the Hebrew text it must follow, 'that the Hebrews also held that a pious man was an immovable fixture; since it is said in Proverbs x. 30, "The righteous shall never be moved"—the *same word* in Hebrew.' Dr. McCaul, from whom we copy this last remark,* says (with Gesenius), that the 'never-be-moved' strictly means never be made to 'waver, to shake, to totter;' that is, agreeably to the explanation of these words already insisted upon, shall never be driven from, or jostled out

* *Aids to Faith*, p. 219.

of, his prescribed or appointed path. In like manner, it is said in 1 Chronicles xvii. 9, 'I will ordain a place for my people Israel, and will plant them, and they shall dwell in their place, and shall be moved no more.' This is very different from saying that 'they shall move no more,' which would be absurd.

The case of apparent conflict between revelation and science just alluded to, arose out of a mistaken interpretation of a text of scripture. Other cases of such apparent discrepancy have arisen, on the other hand, out of a mistaken interpretation of some phenomenon of nature—as, for instance, the production of light before the creation of the sun.

The scientific doctrine, till a comparatively recent period, was that the light of day was produced by the emission of luminous particles from the sun; in the absence of which luminary it was conceived that, of physical necessity, there must be darkness. How then could there be daylight three days before the sun was created, as the scriptural narrative declares there was?

We postpone the consideration of this question till we come to discuss the first chapter of Genesis, in the Section on the Mosaic Cosmogony, merely remarking here, that the scientific hypothesis, that light is supplied by the emission of luminous particles from the luminous body, has now been

abandoned — of physical necessity abandoned; that it is acknowledged by modern philosophers to be erroneous, and that there is no emission of such particles at all; but, on the contrary, that the light of day is the result of undulations of a subtile fluid, quite distinct from the sun; and that but for the presence of this fluid, there would be no light, whether the sun existed or not.

These two instances, of an apparent contradiction between science and scripture, are perhaps the most startling and remarkable that have ever been adduced. In the first, the contradiction disappears when the scripture is fairly interpreted; in the second, it disappears when an erroneous physical hypothesis is abandoned.

In terminating this section, we cannot but remark, that there is often displayed a perverse disposition to take certain passages of scripture, obviously poetical, and as obviously conveying the correct idea under some sublime figure or image, in a rigid literal sense; as if, in the Bible, it were not allowable to array even the grandest conceptions in other than the meanest drapery of words. The Book of Job and the Psalms of David are compositions eminently poetical; and the inspired writers, hampered, as it were, by the poverty of human language, seem constrained, from necessity, sometimes to break forth in metaphor and poetic rapture, when describing

the works of creation, or the dealings of the Almighty with man. Thus the enraptured outburst of David (2 Sam. xxii. 8), 'Then the earth shook and trembled: the foundations of heaven moved and shook, because he was wroth,' has been affirmed to inculcate the physical position that heaven is a solid something built upon a foundation! *

In the 16th verse of the same chapter the same term is employed, but without the same poetic fervour, in reference to the earth: 'And the channels of the sea appeared, the foundations of the world were discovered.' Now whether this be figurative or not, the language is the same, and we presume is employed in the same sense, as that of geologists: 'Beneath the whole series of stratified rocks that appear on the surface of the globe, there probably exists a *foundation* of unstratified crystalline rocks.' (Buckland's *Geology*, vol. i. p. 39.)

In another passage (Job ix. 6) the term, *pillars*,

* Mr. Goodwin, though contending for a literal interpretation of the above passage, himself uses the following language: 'This earth, apparently so still and stedfast, lying in majestic repose beneath *the ethereal vault*,' &c. But what would he think of any one who should quote *him* as announcing the physical doctrine that heaven is a *vault*? A vault must have a *foundation*, some structure to support it. (See *Essays and Reviews*, p. 212.) Upon such principles of literal interpretation the Deity Himself is but a geological upheaval — a '*Rock*.'

is used in much the same sense, instead of foundations: 'He shaketh the earth out of her place, and the pillars thereof tremble.' And here we may notice, in passing, that the ecclesiastics, prior to the times of Galileo and Copernicus, might have adduced this passage in disproof of the 'damnable doctrine' of the *immobility* of the earth. But the same inspired writer afterwards says (xxv. 7), 'He hangeth the earth upon nothing.' Now, there is no contradiction here. In the former passage the word 'earth' has the same meaning as in Gen. i. 10, the *land*; which is ruptured and displaced by the tremulous commotion of that which is beneath — that on which, in a normal condition, it *rests*—as in earthquakes and volcanic upheavals. And it is quite in keeping with this poetic style that the atmosphere should be designated as the 'foundations' or 'pillars of heaven.'* But in the second passage, by 'the earth,' is evidently meant the entire globe — the *world*.

* As in the verse from Samuel, quoted in last page, and in Job xxvi. 11.

SECTION II.

ON THE ORIGINAL CONDITION AND PRESENT FORM OF THE EARTH.—THEORY OF GEOLOGISTS.

WE have spoken at page 29 of physical hypotheses; but what, after all, have these to do with the *creative acts* of Omnipotence? Suppose the corpuscular theory of Light were as universally received now as it was two or three hundred years ago; suppose even that it were the *true* theory, should we feel justified in affirming that the command, 'Let there be light,' must have been a resultless fiat, unless the Deity had been first provided with a sun? We know very well that if a man be shut up in a dark cellar, and have only a lucifer match, he could say, 'Let there be light,' and would instantaneously get it; yet a century ago this would have been pronounced impracticable, unless he had been first provided with flint, steel, and tinder-box. How can man possibly *know* the full extent of even the *physical* agencies at the Almighty's disposal; or rather, how can he ignore the fact, that His supreme WILL

supersedes and renders Him independent of them all? Fifty years ago man was ignorant of the physical agencies even at his own disposal, and is equally ignorant now of many that will, no doubt, be at his disposal fifty years hence. And, in referring to the 'laws of nature,' to explain and account for what took place before man existed, it ought, therefore, to be borne in mind that at no period do we probably know a tithe of the laws of nature, and assuredly not a tithe of the special applications even of those we do know. Many things really explicable by the laws of nature *we* may regard as *inexplicable*, from knowing those laws and their operations only in part.* And, on the other hand, explanations which, on natural principles, may seem satisfactory enough to us now, may, after all, from our present imperfect knowledge, be widely different not only from the truth, but also from explanations still more satisfactory that advanced acquaintance with natural principles may enable us hereafter to offer: they may imply a complication of machinery, a tediousness of procedure, and a demand upon time, from which the reality was altogether exempt. Referring to the homely

* At a meeting of the British Association, a few years since, M. Boutigny caused *ice* to be produced in a *red-hot crucible*: such a thing a century ago would have been regarded by most people (even by philosophers) as bordering on the miraculous.

illustration of the lucifer match, there is not a child of the present day, if called upon to witness the old process, who would not at once pronounce it to be a very bungling and round-about method of striking a light; yet it *does* strike a light notwithstanding.

The laws of nature, and their subserviency to the purposes of man, were as patent to his observation and as available for his use centuries ago as they are now; yet see what steam and electricity have accomplished in modern times—things that *then* the philosophers of the day would have been disposed to regard as physically impossible.

It must be remembered, that physical science is not only limited within the bounds of nature, but that, at every stage of its progress, it is limited within the bounds of the then existing knowledge of nature. If man knew all about it, he might then be in a condition to pronounce with certainty upon what is physically impossible and what is not; and, in such a case, every practical science would at once reach the acme of perfection.

But in all departments of our mechanical and manufacturing arts, the simplification of processes, the economising of time and labour, and the expediting of results, by bringing into operation laws of nature of the applicability of which we were previously ignorant, are the great objects

of experimental research, the discovery of which objects, one after another, from time to time, mark the onward stages of scientific progression of every enlightened community; but to the AUTHOR of them the laws of nature were, of course, all, *and always*, completely known. The idea of *progression* in the knowledge or discovery of any of them by *Him*, is necessarily excluded.

Seeing, then, that through our imperfect acquaintance with physical agencies we are incompetent to pronounce with confidence how certain confessedly natural phenomena are actually brought about, or to what extent and by what physical means even our own art-processes may be expedited and improved, would it not be rash in us—going to the very origin of things—to undertake to decide in how far nature alone was competent or incompetent to contribute to any accomplished result; and to what extent the supernatural element was absolutely necessary? But 'physical science has nothing to do with the supernatural.' True; and therefore physical science has nothing to do with the immediate and direct operations of Deity. Where this element is absent, there can be only natural cause and effect, and consequently no *direct* act of the Almighty. The province of physical science is doubtless the province of nature — and that in its fullest extent; but if science travel back to 'the

beginning,' to the commencing boundary of its territory, it must there stop. If it trespass beyond, its torch must go out, and all will be darkness and utter bewilderment. In such a helpless predicament science cannot advance a step: we may indeed indulge in dreams, and frame conjectures as to what *may be*; but of what *is*, and what *must be*, we can really *know* nothing.

One of the most notable of these conjectures is that upon which modern geologists, and certain modern astronomers, found their theory of the earth.* It is this: that 'Originally the earth was a mass of fluid matter in a state of igneous fusion; it assumed the globular form in virtue of the mutual gravitation of its parts. Launched by the Creator into space with a motion of rotation round a certain diameter as an axis, it took the form of an oblate-elliptical spheroid, flattened at the poles, in virtue of the centrifugal force attending its rotation. The degree of spheroidal ellipticity being of course precisely that which corresponded to its velocity of rotation.

'In this state its extremely exalted temperature would not only maintain the matter at its surface

* 'Les physiciens attribuent la forme aplatie du sphéroïde terrestre à un état primitif de fluidité.'—Francœur, *Géodésie*, p. 166.

'La terre a donc été anciennement fluide.'—Arago, *l'Annuaire*, 1834.

'It is important to observe that the earth was once in a fluid state.'—*The Ratcliffe Observer*, Replies to *Essays and Reviews*, p. 508.

in a state of fusion, but would also keep a certain portion of the solid matter in a state of sublimation, and all the liquid matter in a state of vapour suspended in and mixed with the atmosphere.

'After a continuance of greater or less duration in this state, the heat of the globe being continually radiated into the surrounding space, the temperature of its surface would be gradually diminished, and would, at length, fall below the point of fusion of the matter composing its surface, and consequently the superficial part would be solidified, and the globe would be coated, as it were, by a thin skin or shell of solid matter, enclosing within it the matter still remaining in fusion. By the continued effect of radiation the temperature of the surface would continually decrease, and consequently the thickness of the solidified shell would be continually augmented. At length the superficial temperature would fall to such a point that the sublimated matter would be precipitated on the surface, and when the superficial temperature, falling still lower, would descend below the boiling point of water, a general condensation of the vapour suspended in the atmosphere would ensue, and the entire surface of the globe would be covered with an ocean of uniform depth.

'If no disturbing force acted, this would have continued to be the condition of the globe; but

the fused matter enclosed by the solid crust being subject to effects more or less irregular, and exercising unequal pressures, it was in some places protruded upwards, and in others depressed. In this manner certain parts of the solid crust were pushed above the level of the water, while others may have suffered corresponding depressions. Instead, therefore, of a universal ocean, the surface became diversified by land and water.

'The action of the water upon the subjacent crust of the earth, by erosion and disintegration, and exposure to atmospheric action, produced various changes in its condition; and the parts thus washed off being subsequently deposited at the bottom of the waters, produced the incipient stratification which has been above described.

'When the temperature of the globe was reduced to such a point as to be compatible with the existence of organised bodies, the first forms of life were called by the Creator into existence, and were such as were adapted to the then physical condition of the globe, being, as might be expected, exclusively marine tribes. When subsequently land emerged from the ocean, and, by the condensation and precipitation of vapour, rivers and lakes were formed, terrestrial, fluviatile, lacustrine tribes were called into existence.

'As each successive stratum was thus formed, the remains of the animals and vegetables of the

epoch were deposited in them, and have accordingly been preserved to our times. Fluviatile and land animals, in greater or less numbers, were swept into the embouchures of rivers, and these deposited like the others. Lacustrine tribes were, in like manner, deposited in the bottoms of vast lakes or inland seas.

'But besides these, there are indications of other changes, either gradual or sudden, which would explain the deposition of terrestrial organic remains in the strata. There are evidences that the swellings upwards and subsidences downwards of the crust, by the internal movements of the fluid nucleus of the globe, caused various changes in the distribution of land and water, so that parts of the globe which at one time were raised above the waters, and inhabited by terrestrial tribes, were subsequently submerged; while other parts, being elevated, emerged from the waters, and formed new continents or islands. Indeed, changes which are in actual progress, and which will be presently noticed more fully, show that phenomena are still produced, though probably on a much smaller scale, than at the earlier stages of growth of the earth when its crust, having less thickness and strength, offered less resistance to the internal movements of its fluid nucleus.

'Since the strata were deposited during a succession of periods of long duration, each receiving

the remains of the organised tribes which inhabited the earth at the period of its deposition, it follows that the organic contents of these successive strata may be regarded as so many museums, presenting to us specimens of the zoology and botany of the globe at the successive periods of their deposition. By examining, therefore, these remains, we shall be able to compare with each other, and with the existing tribes, the living inhabitants of the globe at the several periods of the formation of these strata.' *

Such are the fundamental dogmas of the geologists' philosophical creed. We have given them here at length, because of the clear and popular and connected form in which they are laid down by the writer from whom we have quoted. The reader is earnestly requested to examine them very attentively, and then, if he know anything of science in general, to ask himself if the fanciful scheme here depicted deserves to be called a strictly scientific theory. What is the hypothesis, the primary assumption? Why, that the earth orginally was a globe of fluid molten matter. Being a globe, all the parts of it, equidistant from the centre, must have been in the same condition; and when, by cooling, the outer crust had formed, every part of that crust must have been (at least

* Lardner's *Popular Geology*, articles 49–52.

as to thickness) in the same condition. Upon this crust the internal molten fluid exerted an expansive force (how it acquired this force is not stated), by which 'certain parts of it were pushed up,' while at the same time, or afterwards, certain other parts 'suffered a corresponding depression.' Is this consistent — that the same expansive force should push up and pull down — be at once propelling and tractile? And why, seeing the physical necessity of uniformity of condition of the whole, *all* the crust should not fare alike, is hard to conceive; and still harder is it to conceive that a piece of crust, once up, should go down again, or, once down, go up again. Yet these alternate uprisings and down-sinkings—this game of geological see-saw — was not played out till twenty-eight or twenty-nine alternations had been gone through. But it must be admitted that, though all parts of the crust had equal claim to rise or fall, yet the apparent want of fair play was, in the long run, equitably compensated: every part had its innings, and the very ground which the reader now occupies has bobbed up and down at least eight-and-twenty times! Such is the doctrine in nearly all the books.

Observe, too, in the foregoing detail of operations, the sort of copartnery in the work between God and Nature—the ingenious division of labour. The Creator supplies the raw material, already in

a molten state; Nature then takes it in hand, and shapes it and cools it, so as to fit the waters that surround it for marine tribes, which Deity forthwith supplies. Nature again steps in, and, by upheavals, presents to Omnipotence some dry land, 'compatible with the existence' of land organisms, with which it is, of course, speedily furnished; and so on, as narrated above.

In a human construction something very analogous to this is certainly done, for it is unavoidable. The carpenter waits for the bricklayer, and the paper-hanger for the plasterer; but we hardly think that the supernatural is ever kept in abeyance and inoperative, waiting for the natural — the Creator for the creature; and this mixture of the two should, we think, take the theories of geology out of the category of science. It is, moreover, a very confused mixture — so confused as to make it difficult to discriminate between God's portion of the work and Nature's. Which of the agencies was it that caused a uniformly cooled crust, covering a uniformly hot molten mass, the whole in the form of a perfect sphere, to be thinner in one part than in another? The least thickness, it is conjectured, is 'from thirty to forty miles;' * the greatest, 'about one hundred miles.' †

* Lardner. † Buckland.

If it be answered, that it was caused by 'the fused matter enclosed by the solid crust being subject to effects more or less irregular, and exercising unequal pressures,' we reply, that 'effects more or less irregular' may produce anything. What caused the irregularities themselves? Geology is silent.

Again: what caused the twenty-nine oscillations to and fro — the alternate upheavals and downsinkings — of the same portion of crust? The answer is, 'the swellings upwards and subsidence downwards of the crust, by the internal movements of the fluid nucleus of the globe, caused various changes in the distribution of land and water, so that parts of the globe which at one time were raised above the waters, and inhabited by terrestrial tribes, were subsequently submerged, while other parts, being elevated, emerged from the waters and formed new continents or islands.' But what caused the *cause* of the swellings upwards and subsidences downwards — the internal movements of the fluid nucleus *itself*? Geology is again silent. Is it a satisfactory explanation of the swellings upwards and subsidences downwards of one thing, to say that they are caused by the swellings upwards and subsidences downwards of something else? It is the oscillations of this something else that we want accounted for.

It is not sufficient to point to 'phenomena still

produced' by natural causes, to justify the *assumption* of these periodical oscillations. Volcanoes unquestionably produce upheavals, and earthquakes down-sinkings: the dry land too has been sometimes invaded by the sea, and a portion of the bed of the sea left dry by the retirement of the waters. It may be true that 'the apparent change of level of the sea is produced by a slow and gradual upheaving of the land in some places, and a sinking in others; that in Finland, and in a great part of Sweden, the surface was gradually raised without any perceptible shock, while in the southern parts of the peninsula a corresponding depression was produced;' that 'for four centuries, the western coast of Greenland has been continually sinking through an extent of 600 miles north and south. Ancient buildings, as well upon the low islands of the coast as upon the mainland, have been gradually submerged; and the removal to a considerable distance inland of various establishments which formerly existed upon the coast, has been rendered necessary. Similar sinkings of the surface have been manifested in certain islands of the Southern Ocean, especially in the Indian Archipelago.'

But how can these interesting facts justify the assertion that 'The alternate upheavings, depressions, disruptions, and dislocations of the crust of the earth, assumed by geologists in their

explanation of the phenomena, are still exhibited?'*

It is both unfair and inaccurate to assimilate the local effects of volcanoes and earthquakes to oscillations of the molten nucleus of the earth. That cavities now exist, at a comparatively small distance below the earth's surface, occupied by expansive gases, hot fluids, and molten matter, these phenomena sufficiently indicate; and in volcanic localities, where these cavities are more prevalent, and therefore the liabilities to disturbance more frequent, we may expect occasional risings and sinkings of the ground; as in the case of that on which the temple of Jupiter Serapis stands, at Pozzuoli, near Naples, which, in consequence of a volcanic eruption, attended with earthquakes, sank so that the columns of the temple were in part submerged in water. Upwards of three centuries after, other earthquakes and volcanic eruptions, in the same locality, raised the coast, it is said, twenty feet, bringing the partly submerged columns again above water.

But what have these purely local, and comparatively most trivial effects to do with the vast molten nucleus of the earth—even admitting such a thing to exist? We think it would have been more judicious in geologists to have suppressed all mention of them, as they can afford not the

* Lardner, art. 110.

slightest confirmation of their igneous-fluid theory. They are sufficiently accounted for, without all this immense mass of boiling fluid, simply by the admission of local cavities, beneath the outer skin of the earth, occupied by hot steaming matter — cavities similar to those so often discovered in large iron castings, called *flaws* and *cold shots*. The case is certainly not a mountain labouring to produce an insignificant mouse; but it is a molten globe of 7,900 miles in diameter labouring to produce an insignificant mountain.* Is not the philosophical maxim—that a physical hypothesis should never demand gratuitous admission for anything more than the phenomena to be explained absolutely requires, here disregarded? (See the masterly 'Researches on Earthquakes,' by Mr. R. Mallet, of Dublin.)

In the popular and very clearly written compilation on Geology which we have hitherto quoted, it is affirmed — quite in accordance with the generally received theory — that 'If the egg of a fowl be imagined to represent the earth, its shell would be much too thick to represent its solid crust.' (Art. 13.) And upon this extraordinary assumption of so thin a crust, and so

* Not only are extensive mountain ranges attributed to the molten nucleus bursting through the solid crust of the earth, but every solitary rock is maintained to have been produced by the same cause.

voluminous a mass of enclosed igneous fluid, all the geological deductions are based. Now Mr. Hopkins of Cambridge, himself a practical geologist, and moreover a man of the very highest ability and attainments in mathematical and physical science generally, has proved, from clearly ascertained astronomical phenomena, that the earth's crust cannot possibly be thinner than from 800 to 1,000 miles, or about a fourth part of the entire radius! (See Phil. Trans, 1839-1842.)*

Instead of having such a crust as this to get through — in place of their mere egg-shell crust, we submit that it would be an improvement, and —keeping the above-mentioned maxim in view— more philosophical, if geologists would reverse their fundamental hypothesis: have the shell *fluid* and the egg *solid*. A depth of 15 or 16, or at most 20 miles of molten matter, spread over a solid globe, would, as it cooled, serve all the purposes of their upheavals and subsidences — serve to explain all the stratifications, all the deposits, and all the phenomena of organic remains; and would, at the same time, save them from falling foul of the truths of astronomy.

* Mr. Hopkins' 'Researches in Physical Geology' consist of four Papers in the Philosophical Transactions. The last of these important and elaborate investigations was read before the Royal Society in January 1842. An abstract of it will be given in a NOTE at the end of the present volume.

Such a fluid covering would be sufficient to account for the flattening at the poles, and the protruding at the equator, of the rotating sphere, thus changing its surface into the spheroidal figure. The time for cooling and solidifying the outer skin would be immensely less than that which would be requisite in the other hypothesis; and the solidified crust would increase in thickness with corresponding rapidity. And, at any stage of the cooling process, the still molten matter, embracing the solid nucleus of the earth, might exert all the energies attributed to that nucleus itself on the supposition that *it*, also, is molten. The vast geological periods would thus become greatly contracted in duration, and we cannot see that any of the phenomena of geology would be of more obscure or difficult explanation than they now are on the extravagant hypothesis that the whole globe of the earth was originally a mass of incandescent matter.

It would be quite a mistake to suppose that Newton, because he investigated the figure of the earth on the hypothesis of its original fluidity, really thought the earth ever to have been fluid. His convictions were quite the contrary. He based his most remarkable and profound investigation of the figure of the earth on the hypothesis that it was a homogeneous fluid, because only on this simple hypothesis could even his gigantic

intellect grapple with the problem. Even if he had assumed it to have been the gross and turbid mass of molten matter which geologists contend for, the investigation would still have been too difficult; as such a mass could not be subject to the same hydrodynamical laws as those which govern the movements of a pure fluid; and in order to approximate to its figure, it was a pure homogeneous fluid which of necessity — mathematical necessity — constituted Newton's hypothetical earth.

But this man of wondrous intellect, and of almost prophetic sagacity, never adopted the notion that the actual earth was ever fluid at all. What his views on this subject really were we here give in his own words: —

'It seems probable to me that God, in the beginning, formed matter in solid, massy, hard, impenetrable, moveable particles, of such sizes and figures, and with such properties, and in such proportion to space, as most conduced to the end for which He formed them.'

'These hard and solid particles were variously associated, in the first creation, by the councils of an intelligent Agent; for it became Him who created them to set them in order; and if He did so, it is unphilosophical to seek any other origin of this world, or to pretend that it might arise, out of a chaos, by the mere laws of nature.

Though, being once formed, it may continue by those laws for many ages.' (Newton's *Optics*, p. 378.)

These quotations sufficiently show that, notwithstanding Newton's *hypothesis* of a fluid earth, his *belief* was that it was formed 'in the beginning' of solid matter. He did not assume its fluidity as a thing of necessity with GOD, but as a thing of necessity with *him*. Great as were his intellectual powers, the problem of the determination of the figure of the earth, upon physical and mathematical principles, taking the earth to be constituted as he believed it to be, was a problem beyond the reach of even *his* powers. In order, therefore, so to reduce its difficulty as to bring it *within* that reach, he hypothetically changed the materials, and made the earth fluid, in the hope of obtaining at length an approximation to the actual truth.

And even at the present day — with all the additional resources which a more advanced state of mathematical science places at the command of the investigator — an approximate solution only of this great physical problem is all that is attainable.

It cannot be otherwise; for every solution which is based upon considerations of the interior constitution of the earth, must of necessity involve, in its very data, assumptions and hypotheses as to an unknown structure, the truth of which hypo-

theses we not only have no means of verifying, but which we believe would not be strictly verified, if the interior were to be exposed to our examination. In fact, though the materials of the earth, from the surface to the centre, were to be actually submitted to our inspection, there is but little reason to think that the knowledge to be acquired from that inspection would profit us much in the investigation of its external figure: the solution of the problem would still be but approximative.

It is no doubt comparatively easy, when the only difficulty consists in a choice of hypotheses, to assume the original condition for a planet to have been such that, bringing to bear upon it agencies known and unknown, whatever we please, we may account for the phenomena which an exploration of its surface actually exhibits, and thus dispense with all supernatural power.

Such an investigation would be analogous to that of certain problems in pure mathematics, which run thus:—Given, such and such data, work out such and such conclusions, without the aid of the differential calculus. So in the geological problem:—Given, a sufficiency of molten matter, and what we now call the laws of nature, with time *ad libitum* for their operation, construct the earth's crust, without the aid of a Deity. In both problems thought, and ingenuity long exercised, may conduct the hampered inquirer

successfully through the intricacies of the narrow path prescribed to him, and the desired conclusion be satisfactorily reached. But in neither case may the process be at all like that of the original proposer and solver of the problem.

The earth on which we tread is *a reality* — the work of Almighty Power: the earth to which science invites our attention is an *imaginary* — a purely hypothetical earth. In the former work, we know nothing as to the instruments employed, or the time consumed; what is actually done is quite enough for man to inquire into, without attempting the hopeless task of searching out the mode of operation — without going back, ages before Adam, to discover how Omnipotence was then preparing the present crust of the earth. By only going back to many ages *after* Adam, we cannot satisfactorily find out how certain existing *human* structures were actually built: we do not *know* even yet, how the ancient Egyptians constructed their pyramids or reared their splendid cities; nor how the mighty monoliths of Alexandria were hewn and transported, and erected where they now stand.*

* Speaking of Memphis, M. Champollion says, 'I shall take care not to describe anything; for, either my description would not express the thousandth part of what ought to be said, or, if I drew even a faint sketch, I should be taken for an enthusiast or perhaps a madman. It will suffice to add, that no people, either ancient or modern, ever conceived the art of architecture

In the hypothetical earth of Newton — a globe of homogeneous fluid, the ratio of the polar to the equatorial diameters, when rotation had converted the fluid globe into a spheroid, was found to be 229 : 230, a ratio which was afterwards confirmed, and by a less imperfect theory, by

on so sublime and so grand a scale as the ancient Egyptians. Their conceptions were those of men a hundred feet high ; and the imagination, which in Europe rises far above our porticoes, sinks abashed at the foot of the 140 columns of the hypostyle hall at Karnac.'

'The Alexandrian pillar (that of Pompey, or rather of Diocletian) stands upon a pedestal twelve feet high. The shaft is round, about ninety feet in length, and surmounted by a Corinthian capital which adds ten feet more to the elevation. The column, we believe, is one block of porphyry, although it has more usually been described as consisting of syenite or Egyptian granite. It is nine feet in diameter.'— *Ancient and Modern Egypt*, by the Rev. Michael Russell, LL.D., pp. 210, 211.

'We know that the practice of erecting monolithic temples, or sanctuaries hollowed out of a single stone, was very general in Egypt; some striking specimens being still preserved in the higher parts of the country. But we question whether the powers of modern mechanics could remove from the quarry and convey to the distance of four hundred miles a mass of rock thirty-two feet long, twenty-one broad, and twelve in height. It is only in a nation where the Pyramids continue to bear witness to the astonishing effects produced by labour and perseverance that such things must not be pronounced incredible.'—*Ibid.* p. 168. But even such a mass of stone as this is trifling as compared to that of the Great Sphinx, which is one solid piece of rock. 'Pliny estimated it at a hundred and thirteen feet long, and sixty-three in height.'—*Ibid.* p. 164.

Herodotus and other ancient writers give some details (derived from tradition) respecting the construction of the Pyramids, but they are meagre and unsatisfactory.

Maclaurin. More recent determinations on the same principles make the ratio 230 : 231. The hypothesis of pure fluidity is an extreme one in a particular direction. The hypothesis proposed by Huygens is an extreme one in the opposite direction: it is nearly equivalent to this, namely: 'Suppose the only forces which act on each particle of a *heterogeneous* fluid to be these: an attraction (not to every other particle but) to the centre, varying inversely as the square of the distance from the centre, and the centrifugal force resulting from rotation round an axis passing the centre.'* This hypothesis would amount to the assumption that the matter near the centre is infinitely more dense than that near the surface, in which case the ratio of the axes would be 580 : 581. And as the earth, in every actual condition of it must be a body between these two hypothetical extremes, we may safely conclude that the true ratio of the diameters is greater than 230:231, and less than 580 : 581. From the actual measurement of degrees on its surface — a mode of determination, of course, wholly independent of the interior constitution of the earth — the ratio of the diameters, taken, as an average, from a great number of results, is found to be 298 : 299.

* Airy, on the 'Figure of the Earth.'— *Encyc. Met.* pp. 176, 190.

But neither from physical theories nor from geodetic measures, nor from pendulum experiments, is the figure of the earth even yet determined with strict accuracy—all the results disagree more or less. In fact, there is every reason to believe that the surface of the earth, abstracting from it all its superficial irregularities, and reducing all the measurements to the level of the sea, is not any strictly mathematical figure at all:* the spheroidal is the only such figure that makes the nearest approach to its actual form, which, however, is so nearly globular that 'if the form of the earth's meridian were traced upon paper the nicest eye would be unable to distinguish it from a circle. The ellipticity is so small that the closest inspection, without measure, could not judge which was intended for the greater and which for the smaller axis. The whole quantity in dispute is less than one-sixteenth of this ellipticity. Instead of being surprised that such a difference exists, we may well be astonished at the accuracy of modern measures of all kinds which make so small a quantity a subject of controversy.' †

* 'On ne peut refuser de reconnaître que, même en dégageant par la pensée la surface terrestre de ses inégalités, qui ne sont jamais que des accidens minimes, et sans importance pour notre objet, la terre n'est pas rigoureusement *un solide ellipsoïdal de révolution*.'—Francœur, *Géodésie*, p. 184.

† 'Figure of the Earth,' p. 231.

From the average of all the most trustworthy geodetical measurements, the ratio of the polar and equatorial diameters is found, as stated above, to be 298 : 299. This ratio gives for the earth's ellipticity $\frac{1}{299}$. And the Astronomer Royal, from whom we have just quoted, concludes his learned and elaborate inquiry into the various methods of determining the figure of the earth thus :—

'The measures of the earth, the observations of pendulums, and the lunar inequalities, agree in showing that the earth's form does not differ much from that of an ellipsoid of revolution, whose ellipticity is (we think certainly) greater than $\frac{1}{300}$, and whose major semi-axis is about 20,923,700 English feet.' The three hundredth part of this gives 69,746 English feet for the extent of flattening at the poles, that is $13\frac{1}{5}$ miles and 50 feet.

That the flattening at the poles is about this quantity, and not more, is thus an established physical truth; but that the figure of the earth — abstracting all inequalities of surface — is strictly that of an ellipsoid of revolution, is a position that science opposes, rather than confirms. There is, in fact, reason to believe, from all that has hitherto been done, that no single meridian of the earth, though reduced accurately to the level of the sea, when quiescent, is a perfect ellipse.

The unavoidable conclusions from what has now been advanced are:

1. That if the earth were ever a fluid globe, converted into a spheroid by rotation, some force, unaccounted for on physical principles, must have afterwards modified the figure of its surface.

2. That local earthquakes, such as now take place, and the elevation of mountains above the normal level, are phenomena too insignificant to modify sensibly the figure of the ocean's surface.

3. That a single extensive upheaval, or a single extensive subsidence, or, more effectually, a combination of the two, would adequately account for the observed deviation of the ocean's surface from the prior spheroidal form.

A strictly spheroidal form, the result of rotation about a diameter of a perfect sphere, the superficial parts, at least, of which were fluid, is that which, whether rightly or not, it is agreed, on all hands, the earth *once* had.* But what if the

* 'We may further remark, that if we suppose a solid nucleus to exist similar in general constitution to what we have assumed to be the state of the earth, but having for its different strata any arbitrary densities and ellipticities, and then if we suppose fluids of different densities to be suffered to arrange themselves freely round this nucleus, the same expressions will hold for the forces, as if the whole were fluid (the integrals being taken as well for the solid as for the fluid parts). And, therefore, the equations respecting the surface (which are in fact the only important ones, the others being only useful in conducting us to them) are equally true, whether the whole be supposed to be fluid, or a fluid

earth, *originally*, had no rotation at all? What if, *originally*, instead of being a globe, it was, in a geometrical sense, 'without form'?

Such an irregular mass of land and water would present a surface much greater than a globe of the same mass would do; and if that surface received its heat from internal sources, all varieties of temperature might be found upon it. The plains and valleys nearest to this internal heat might have a temperature sufficiently high to support existences that could thrive only in the hottest regions, and the more elevated parts might pass through all gradations, from this extreme of heat to the opposite extreme of intense cold. Such a body would be habitable by all those varieties of animal and vegetable life which appear to have existed during the pre-human period, and they could all have existed *contemporaneously*. Instead of latitude determining or influencing climate, climatic condition would be dependent upon distance from the interior source of heat. Lakes and seas could exist in what we should now call an inclined position, and the detritus carried into them by rivers would harden at the bottom in that inclined position. In other localities, waters would settle in what we should now call a horizontal plane.

heterogeneous mass be supposed to surround such a nucleus.' —Airy, *Figure of the Earth*, p. 187.

There is nothing in this to oppose the law of gravitation. Every mass, however irregular, has a centre of gravity; but no mass which is not globular has a centre of gravitation or attraction, and the attracting matter may be so disposed as to allow a fluid to remain in equilibrium at any inclination whatever. After existing for ages in this state, the animal and vegetable tribes living and dying in their respective regions of temperature, suppose that, either by the actual transportation bodily of the more prominent matter, or by a relaxation of its force of cohesion, or by a combination of these, the globular form were to be assumed, all the waters would then coalesce to form a fluid covering, underneath which would lie superposed, one on another, the various strata (the upper having been shifted over the lower), with their appropriate organic remains, much as geologists find them now.

This hypothesis, as to the original condition of the earth, would dispense with those enormous periods of time required to cool the surface of a molten globe of such a size, and fit it for the habitation of the lower forms of animal and vegetable life. It would dispense with the twenty-eight or twenty-nine successive creations, and the vast intervals between each, which were rendered necessary to adapt the surface to the more advanced forms of organised existences; and it

would dispense also with so many upheavals and subsidences. All the forms of life would exist contemporaneously: prior to man, there would be but one creative epoch, and but one upheaval and subsidence.

And we submit that such an hypothesis deserves, at least, as much countenance, even on physical principles, as the molten-fluid hypothesis of the geologists. If it be asked, how, upon physical principles, the transportation or the disintegration of the protuberances of the irregular earth are to be accounted for, the reply might be, a promise to account for it so soon as geologists account for the heat that provided them with a molten globe nearly 8,000 miles in diameter—so soon as they account for the departure of this fluid globe from the spherical or spheroidal form, by swelling out in various parts, breaking through the hardened crust, and elevating itself, in the form of mountains, miles above it—raising sea-beds into continents, and depressing continents into sea-beds.

According to *their* doctrines, there have been twenty-eight or twenty-nine of these catastrophes, involving as many destructions of animated nature. The earth has been covered with water, not once only, or twice, but the above-mentioned number of times; not universally covered, but all in distinct portions, at different epochs. When any

submerged portion again rose, it rose prepared and adapted for an order of existences a stage in advance, as respects organisation, of those that had previously inhabited the same region, and had been ages ago destroyed.

Now, the earth being a globe, or differing from a globe by only a very trifling amount, all places on its surface must have been, and are admitted to have been, equally hot or equally cool; and therefore all alike equally suited to the very same tribes of animal and vegetable life; these accordingly, as is also admitted, existed contemporaneously all over the earth's surface. But when one region of surface, having been submerged, uprose — or even suppose that ten or a dozen distinct regions did so simultaneously — and had thus become unfitted for the tribes that had passed away, and suited only for the new tribes then to be introduced, what became of the inhabitants of the *remaining* portions of the earth, whose turn for submergence and subsequent upheaval had not yet come? Did they, contemporaneously with the new creations, continue to flourish, or did they gradually wither and die away — or, still remaining *in situ*, were they simply inundated?* In either case there would be fossil remains of one

* A *subsidence* could not have produced a general inundation of the other parts of the earth, whatever an upheaval may have done.

geological period contemporary with fossil remains of a preceding or subsequent period; and the lithological peculiarities of the one would be of the same age or referable to the same epoch, as the deficient lithological peculiarities of the other, which however is irreconcileable with the geological theory which implies that only strata of the same lithological character can belong to the same age.

'This is the generally current belief. On this assumption the received geological classifications appear to be framed. The Silurian system, Devonian system, Carboniferous system, &c., are set down in our books as groups of formations which everywhere succeed each other in a given order, and are severally everywhere of the same age. Though it may not be asserted that these successive systems are universal, yet it seems to be tacitly assumed that they are so. In North and South America, in Asia, in Australia, sets of strata are assimilated to one or other of these groups; and their mineral characters, and order of superposition, are among the reasons assigned for so assimilating them. Though, probably, no competent geologist would contend that the European classification of strata is applicable to all the other parts of the globe, yet most, if not all geologists, write as if it were so. We venture to say that, among readers of works on geology, nine out

of ten carry away the impression that the divisions, primary, secondary, and tertiary, are of absolute and universal application; that these great divisions are separable into subdivisions, each of which is definitely distinguished from the rest, and is everywhere recognisable by its characters as such; and that in all parts of the earth these minor systems severally began and ended at the same time. When they meet with the term "carboniferous era," they take for granted that it was an era universally carboniferous — that it was, what Hugh Miller indeed actually describes it, an era when the earth bore a vegetation far more luxuriant than it has ever since done; and were they in any of our colonies to meet with a coal-bed, they would conclude that, as a matter of course, it was of the same age as the English coal-beds . . . Every area of subsidence is necessarily limited, and to suppose that there exist elsewhere groups of beds completely answering to these, is to suppose that, in contemporaneous areas of subsidence throughout the globe, the conditions would be such as to cause the formation of oolite, or anything like it, is an assumption which no modern geologist would openly make; he would say that the equivalent series of beds found elsewhere would very likely be of dissimilar mineral character. Not only is it, however, that in these contemporaneous areas of subsidence the pheno-

mena going on must be more or less different in kind, but it is that in no two cases are they likely to agree in their commencements and terminations. The probabilities are greatly against any two separate portions of the earth's surface beginning to subside at the same time, and ceasing to subside at the same time — a coincidence which can alone produce corresponding groups of strata. On the contrary, subsidences in different places begin and end with utter irregularity; and hence the groups of strata thrown down in them can but rarely answer to each other as groups. Measured against each other in time, their limits will disagree. They will refuse to fit into any scheme of definite divisions. On turning to the evidence, we find that it daily tends more and more to justify these *à priori* positions. Take, as an example, the Old Red Sandstone system. In the north of England this is represented by a single stratum of conglomerate. In Herefordshire, Worcestershire, and Shropshire, it expands into a series of strata from eight to ten thousand feet thick, made up of conglomerates, red, green, and white sandstones, red, green, and spotted marls, and concretionary limestones. To the south-west, as between Caermarthen and Pembroke, the series of strata exhibits considerable lithological changes, and there is an absence of fossil fishes. On the other side of the Bristol Channel, they display a further change in

mineral character and remains. While in South Devon and Cornwall, the equivalent strata, consisting chiefly of slates, schists and limestones, are so wholly different, that they were for a long time classed as Silurian.

'When we thus see that in certain directions the whole series of strata thins out, and that its mineral characters as well as its fauna continually change within moderate distances, does it not become clear that the series of deposits called Old Red Sandstone or Devonian was a local one? And when we find in other regions analogous deposits, is it certain—is it even probable—that they severally began and ended at the same time with this? Should it not require overwhelming evidence to make us believe as much?'*

It must be conceded, however, that modern geologists have for the most part felt it necessary to modify their theory, that strata of like mineral character were everywhere deposited at the same period. Dr. Buckland says, 'Indeed, the mineral character of the inorganic matter of which the earth's strata are composed presents so similar a succession of beds of sandstone, clay, and limestone, repeated irregularly, not only in different, but even in the same formations, that similarity of mineral composition is but an uncertain proof

* See a paper on 'Illogical Geology,' in the *Universal Review*, 1859, pp. 63–64.

of contemporaneous origin; while the surest test of identity of time is afforded by the correspondence of the organic remains. In fact, without these, the proofs of the lapse of such long periods as geology shows to have been occupied in the formation of the strata of the earth, would have been comparatively few and indecisive.'*

But we submit that whatever portion of the earth's crust sank down at any time, all the organised inhabitants of that portion sank with it. The same organisms equally inhabited the portions of crust that did and of those portions that did not sink down at that epoch, inasmuch as that the surface was of one uniform temperature.† These latter, therefore, must have sunk at a subsequent epoch: how, then, can it be maintained, that 'the surest test of identity of time is

* Buckland's *Geology and Mineralogy*. Edition of 1858, p. 113.

† 'At length the temperature being reduced to a point compatible with organised life, creative power began to be manifested. The earth was peopled with animals and clothed with vegetation; but these animals and this vegetation differed altogether from those which now animate and cover the globe. They were, however, adapted by Divine Wisdom to the then condition of the earth, the temperature being not only greater than any which prevails at present, but, as has been stated, uniform at all latitudes.'—Lardner, *Art.* 191.

'In all former ages and periods, including those which immediately preceded the present, no traces of climatic distinctions have been found.'—Ibid. *Art.* 561.

afforded by the correspondence of the organic remains?'

'The records of geology furnish numerous cases in which a particular fossil, long considered characteristic of a particular formation, has been afterwards discovered in other formations. Until some twelve years ago, Gonialites had not been found lower than the Devonian rocks; but now, in Bohemia, they have been found in rocks classed as Silurian. Quite recently, the Orthoceras, for years supposed to be a form exclusively palæozoic, has been detected along with mæozoic Ammonites and Belemnites.

'Yet hosts of such experiences fail to extinguish the assumption that the age of a stratum may be safely determined by the occurrence in it of a single fossil form. Nay, this assumption survives evidence of even a still more destructive kind. Speaking of the Silurian system in Western Ireland, Sir R. Murchison says, 'In the beds near Maam, Professor Nicol and myself collected remains, some of which would be considered Lower and others Upper Silurian;' and then names sundry fossils which in England belong to the summit of the Ludlow rocks, or highest Silurian strata; some, 'which elsewhere are known only in rocks of Llandovery age,' that is, of Middle Silurian age; and some, only yet known

in Lower Silurian strata, not far above the most ancient fossiliferous beds.

'Now, what do these facts prove? Clearly they prove that organic forms which in Wales are separated by strata more than twenty thousand feet deep, and therefore seem to belong to periods far remote from each other, were really coexistent. They prove that the mollusks and crinoids held characteristic of early Silurian strata, and supposed to have become extinct long before the mollusks and crinoids of the later Silurian strata came into existence, were really flourishing at the same time with these last; and that these last probably date back to as early a period as the first. They prove not only that the mineral characters of sedimentary formations, but also that the collections of organic forms they contain, are, to a great extent, a question of local circumstances. They prove that the fossils met with in any series of strata cannot, in the least, be taken as representing the whole flora and fauna of the period they belong to. In brief, they throw great doubt upon numerous geological generalisations.' *

It would be easy to multiply such instances of discrepancy between geological theory and geological facts. The paper from which the above

* 'Illogical Geology,' p. 67–8. We quote so freely from this able paper, because appearing, as it does, in a periodical which is now out of print, the original may not be readily procurable.

is extracted abounds with them. Indeed, to be quite consistent, it appears to us that the theory ought to be that the globe, at each of the great geological epochs, was *wholly* broken up, and every portion submerged at the same time; in fact, that it was reduced to a chaos; then re-formed, supplied with new races of organised beings; and, after the lapse of another geological period, again reduced to chaos, and so on.

The ascertained *facts* disclosed by practical geology are indubitable. They are not like moral or political, or even physical phenomena, that may have engaged the attention and exercised the intellects of a bygone age, and then have been admitted by us to have existed on the strength of written reliable testimony. The *facts* of geology we can actually witness for ourselves: they are not evanescent, but permanent phenomena, palpably addressed to our outward senses. The remains of animal and vegetable life which existed prior to the human period can be actually seen and handled, yet no human bones, or traces of human contrivances, have been discovered in the neighbourhood of these deeply-seated pre-Adamite deposits. Geologists agree that in whatever strata of the earth's crust human remains have been found, the age of those strata cannot have exceeded 6,000 years; and this conclusion is uniformly arrived at, quite irrespective of all

regard to scripture chronology. (See *Buckland*, vol. i. p. 101.)

These truths are in accordance with the declarations of Holy Writ, that there was a time, and that not very remote, when MAN began to be; and geology further shows that, prior to his creation, organised existences inhabited the earth, over which he was destined to hold temporal dominion.*

* But we do not feel justified in going the length of Cuvier, Buckland, and others, in affirming that—

'What the more astonishes us, and what is not less certain, is, that life has not always existed on the globe; and that it is easy for the observer to recognise the point where it has commenced to deposit its products.'—*Cuvier.*

'It is demonstrable from geology that there was a period when no organic beings had existence; these organic beings must therefore have had a beginning subsequently to this period; and where is that beginning to be found but in the will and *fiat* of an intelligent and all-wise Creator?'—*Buckland.*

In strictness, geology proves only that there was a period during which no organic remains have been *found*. This is all that is *demonstrable*. Unassisted science—delving in the dark for organic remains—can never arrive at an indisputably affirmative conclusion on such a point as this; it can, at most, show only the fruitlessness of all past attempts to establish the negative.

SECTION III.

THE MOSAIC COSMOGONY.

IN the opening statement of the first chapter of Genesis, Moses does not enter into any details as to the creation, or original occupancy of the earth. He simply makes the brief announcement, that 'In the beginning (however remote that may have been) God created the heaven and the earth.'

Having declared this great truth—namely, that the heaven and the earth were not eternal, but that they had a beginning, and were created by God—the inspired writer takes these creations in the condition in which they existed at a particular epoch (which, according to scripture chronology, is about 6,000 years ago), and enters at once upon an historical account of the additional works of Deity during six consecutive days. It would evidently have been quite extraneous to his purpose to have said anything at all about the state of the earth during periods long prior to the epoch at which his history avowedly commences. Unless directly commanded to do so, and previously

qualified by inspiration, he would, of course, have been incompetent to the task. Moses *himself* could not have known anything about it; and as no additional item to his theological creed, nor any increase of spiritual knowledge or benefits, could have resulted to man from a revelation of what took place on earth before the human period, the Divine record — and to expect otherwise would be to expect that record to be inconsistent with itself — is silent on the subject.

Regarding, then, what was created 'in the beginning,' as stated in the first verse, as totally distinct from the six days' performances, which, in the subsequent verses, Moses relates in chronological order, we might proceed at once to inquire what in each of these six days was actually done, with the view of ascertaining whether, as has been alleged, there be anything in the works themselves or in the order in which they are said to have succeeded one another, 'adverse to modern science.'

But that what was created in the beginning may not be confused with the subsequent creations of the six days, it will be necessary first to ascertain what those material pre-existences actually were. We therefore take —

Verse 1. 'IN THE BEGINNING GOD CREATED THE HEAVEN AND THE EARTH.'

In this announcement two things are stated to have been created, only one of which can be the

subject of any doubt or controversy—'the heaven.' What does the inspired writer mean by the term 'heaven'? From the subsequent use of this term, where he speaks of the creation of 'fowl that may fly above the earth,' and afterwards (v. 26), calls them 'the fowl of the heavens,' * it is pretty clear that he employs the word in the same sense as modern science employs it in; that is, as significant of the luminous expanse above and around us. He evidently refers to the same thing (whatever that be) which we refer to when we speak of the 'blue heavens,' of the 'starry heavens,' or of the 'heavenly bodies;' that is, of those far-off masses which dwell and move in the ethereal regions.

Strangely enough, Moses has been charged with ignorance for not being 'aware that the sky is but transparent space.'† On the contrary, he should have been credited with wonderful wisdom for knowing and stating that the sky is *not* transparent space. By transparent space — which, by-the-bye, is a form of expression very deficient in scientific precision — the author, of course, means mere *empty space*, non-material extension; but nothing is ever said in Genesis to have been *made* or *created* but what is *material*.

* The Hebrew word translated 'air' is the same word as that translated 'heaven' in the first verse.

† *Essays and Reviews*, third edition, p. 220.

If by 'heaven,' or 'the heavens,' Moses had meant what the essayist implies he ought to have meant — 'but transparent space,' mere emptiness, *nothing* — modern science would indeed have been seriously adverse to the inspired narrative; but, strict to physical truth, he explicitly declares that in the beginning, besides the earth, God created a real *something*. And *this* modern philosophers fully recognise, and call the *luminiferous ether*; the existence of which (at least the hypothetical existence), regardless of everything Moses had recorded, they have been driven to assume, by the very exigencies of physical science, in order to account for the phenomena of *light*.

The earlier notion, that the light of day was produced simply by the emission of luminous particles from the sun, was long perceived to involve much perplexity; this was increased when Roemer discovered that these particles must move with the inconceivable velocity of about 192,000 miles in a second of time: how could particles of matter, however attenuated, strike the eye with such a velocity without injuring that delicate organ? how was this continuous loss of substance in the sun repaired? how could it be that a body attracting all the planets that circulate round it, and even exercising the same attracting force to bind together the component parts of its own mass — how could such a body at the same time *repel*

particles of that mass with such enormous velocity from its surface?

But, besides these difficulties and contradictions, the emission theory was found inadequate to account for the observed phenomena of light, several of which were proved to be quite irreconcileable with that theory; and thus, from the very necessities of the case, philosophers were at length compelled to abandon it. They were obliged to assume the existence of an ethereal medium, as a vehicle of light — greatly more subtile than, but analogous to, the air we breathe, regarded as the vehicle of *sound*. Like as the pulsations of the air, occasioned by a sonorous body, produce sound, so would the pulsations of this ethereal fluid produce light; and the most cautious and eminent investigators have found within the last half-century that not only do phenomena of light, hitherto inexplicable, become satisfactorily explained upon this hypothesis of an undulating ethereal medium, but also that phenomena predicted in accordance with this hypothesis become verified by experiment. This has been abundantly proved by Malus, Fresnel, Poisson, Herschel, Airy, Hamilton, Lloyd, Stokes, Powell, and other distinguished men of science of the present century. Herschel says, 'It is a theory which, if not founded in nature, is certainly one of the happiest fictions that the genius of man has yet

invented. It is, in fact, in all its applications and details, one succession of *felicities*; inasmuch as that we may almost be induced to say, if it be not true, it deserves to be.' And Professor Challis remarks (in his recent work on 'Creation in Plan and in Progress'), 'So many phenomena of light have been explained in this manner, that the reality of the existence of the ether is placed almost beyond doubt.'

Is, then, the declaration that — In the beginning God created this 'heaven,' or ethereal substance, 'adverse to modern science?' On the contrary, modern science — taking none of its data from scripture — is obliged to *assume* the existence of such an ethereal substance for the purposes of *light*, which purposes, however — according to modern science — could be accomplished only by giving the necessary motion to its particles. Will anyone say that the Creator could not impress upon it this motion as readily as He could call it into existence?

In Isaiah xl. 22, it is said of God, that 'it is He that stretcheth out the heavens like a curtain;' and on this passage an accomplished Hebrew scholar remarks: 'The Hebrew word here used for *curtain*, means "something tremulous," and as Gesenius gives it, "*a curtain hanging*, so called from its tremulous motion."'*

* The Rev. Dr. M'Caul, *Aids to Faith*, p. 222.

This is a most apt illustration of what modern physical inquirers conceive to be the undulatory motion of the ether. It is not a movement of translation, but simply a wave-like agitation, without any bodily transportation of material. It is frequently likened to the waving or tremulous motion of a shaken table-cloth or sheet, but the foregoing comparison is far better.*

'Physical science,' says the essayist, 'goes on unconcernedly, pursuing its own paths. Theology, the science whose object is the dealing of God with man as a moral being, maintains but a shivering existence, shouldered and jostled by the sturdy growths of modern thought, and bemoaning itself for the hostility which it encounters.' What Mr. Goodwin himself may have done to expedite this onward march of physical science, we have no means of knowing; but we think that his acquaintance with what others have done in physical science, at least in physical optics, cannot be very extensive, or he would scarcely say, 'light, and the measurement of time, are represented as

* 'If any floating body be placed on the surface of the water, it will not be carried along by the waves; and if similar waves be formed, as they might be, by giving a peculiar motion to a sheet or cloth, they would have the same appearance of progressive motion, although the parts of the sheet or cloth, as is evident, would have no other motion than the up-and-down motion that would form the apparent undulations.' — Lardner, *Popular Astronomy*, p. 200.

existing before the manifestation of the sun, and this idea, *although repugnant to* our *modern knowledge*, has not in former times appeared absurd.' This word OUR must not include the distinguished men whose names have been mentioned above; the existence of the luminiferous ether before the manifestation of the sun, would not be repugnant to Sir John Herschel's knowledge, as the preceding quotation sufficiently shows: if that remarkable man were asked whether this ether or the sun existed first, or whether they both came into existence together, his answer would doubtless be, that 'physical science' tells him nothing about it: *he* would assuredly not discover the absurdity which Mr. Goodwin sees at a glance, whichever of the hypotheses be assumed.

If we admit the well-established facts of geology—and we cannot dispute the *facts*, whatever opinion we may form as to the theories proposed to account for them—we must admit that, previously to the six days' creation, seeing, hearing, and breathing animals existed on the earth, and consequently that both light and air were antecedent to the Adamite period. If Moses had declared the contrary, and had spoken in Genesis of the *creation* of light and the *creation* of air as a part of the six days' operations, scripture and modern science would most certainly have been at variance. But there is no such disagreement.

When pre-Adamite life was extinguished, *light* was extinguished too, as we learn from verse 2; but the *material* of light was not annihilated. The fiat, 'Let there be light,' called the pre-created matter of light into renewed *activity*, and nothing more; for we do not find the Divine utterance followed by the declaration, 'And God *made* the light,' as in the other acts of the six days—the expressly material creations.

It may perhaps be said, that when animal and vegetable life had become extinct, *air* was as unnecessary as light: why was the latter extinguished and the former preserved? The answer is obvious. Had the vibrations, essential to light, of the luminiferous ether been kept up, there would have been a purposeless expenditure of power; had the air been annihilated, there would have been a purposeless destruction of material, and of material, too, which was afterwards to be replaced. Such would be very unlike the procedure of a prescient Being. Besides, from everything that we know of the works of God, either from scripture or from science, there is nothing to justify the conclusion that He *annihilates* any material thing that He has once created: whatever changes of form and separation of parts time and decay may bring about, there is no absolute annihilation of material. It is as beyond the power of Nature to annihilate as it is beyond the power of Nature

to create: the one act and the other must be alike supernatural. If breathing animals existed at any time during the pre-Adamite period, air must have existed contemporaneously with them, and, in conformity with the principle just stated, must have continued to exist even after animal life had become extinct. The extinction and subsequent revival of *motion* are very different things from the extinction and subsequent *creation anew* of matter. The motion necessary to light would cease upon the withdrawal of the moving cause, and would recommence so soon as that cause again operated, the material itself, once created, remaining as in the beginning.

Taking note, therefore, of what is distinctly *included* in the first verse, and of what is as plainly *excluded* from all the other verses, we may fairly infer that both light and air existed previously to the commencement of the six days' work. Whether or not the latter was created 'in the beginning,' as well as the former, cannot be positively determined; but, from the marked silence throughout the Mosaic narrative respecting everything that occurred *between* 'the beginning' and the human epoch, it is reasonable to conclude that air was *not* created in the beginning, contemporaneously with light and the earth, but at some later period of that pre-Adamite interval: the period, namely, when breathing animals were first introduced.

After the brief announcement of the creation of heaven and earth by God, Moses proceeds, in the second verse, to describe the condition of the latter body at the time when a great and important change was about to be effected upon it, and when another manifestation of creative power was about to take place. He says:—

Verse 2. 'AND THE EARTH WAS WITHOUT FORM, AND VOID; AND DARKNESS WAS UPON THE FACE OF THE DEEP: AND THE SPIRIT OF GOD MOVED UPON THE FACE OF THE WATERS.'

We thus learn—what science can neither teach nor contradict—that there was a period when the globe we inhabit was a shapeless mass, and when whatever organisms had previously occupied it had become extinct—it was 'void.' As all life, animal and vegetable, had disappeared from its surface, is it reasonable to suppose that *light* would, notwithstanding, continue to have been supplied?

From the presence of seeing animals, geologists, as already noticed, reasonably infer the contemporaneous existence of light, but they would surely admit that, when all animal and vegetable life had become extinct, light would have been superfluous; and as we have no ground for assuming that even Omnipotent Power throws any of that power away, we feel prepared to expect that the extinction of light would follow the extinction of life; in other words, that the ethereal undulations would cease,

and the ether itself, be—not annihilated—but reduced to quiescence. Moses accordingly adds, 'and darkness was upon the face of the deep.' The remaining words of this second verse are, 'And the Spirit of God moved upon the face of the waters.' On this it might be presumption to speculate; but whatever the mysterious operation implied in these words was, it is reasonable to conclude—since Moses tells us that the earth was previously 'without form,'—that its present rounded shape was then given to it, and that rotatory and progressive motion was also communicated: it is a known mechanical principle, that whatever single impulse produces rotatory motion in a free body, the same impulse gives to the body progressive motion also, that the progressive motion must be in a straight line, and that this onward path the body would continue to describe so long as no new influence operated on it. In reference to the words just quoted, 'And the Spirit of God *moved* upon the face of the waters,' we think it deserving of special attention that these are the only words throughout the entire description which imply a *moving influence.* Surely this, like every one of the subsequently recorded acts, must have been followed by a *result*; but no result, except motion, can reasonably be imagined; and in describing the operation by which the earth was first rolled forward in space,

no merely human language could well be more significant and expressive than that which Moses has employed.*

Moses distinctly states, in the first clause of the above verse, that at the commencement of the epoch to which his historical account exclusively relates, 'the earth was without form.' Whether or not it had always been so is not recorded; but, indulging in reasonable conjecture, we think it highly improbable that it ever had a globular, or a nearly globular form, during the pre-Adamite period; it seems unlikely that the earth should have originally had a globular figure, then have been converted into a shapeless mass, and then have assumed the globular form again. Nor have we the slightest grounds for supposing the mass to have had rotation, even if we attribute to it sphericity. It would puzzle those who insist upon the rotatory motion of the earth, from the beginning, to discover what purpose rotation could serve; unless, indeed, they are determined to oppose the only record we have of God's creative operations, and insist upon having a *sun* ages before that record plainly declares it to have been made; which sun, by-the-bye, would have been of no service to the geologist, but, on the contrary,

* The motion of the *ether*, adverted to at p. 87, is merely a motion of vibration or pulsation, not of progression: there is no transportation of material at all.

would have been a hindrance, since its heat, poured on the earth's surface, would, to a certain extent, have retarded, by counteracting the desired cooling of the crust. There are no geological facts which necessarily imply that, during the pre-Adamite period, the earth had either a spherical form, or any rotatory or progressive motion. If, on the contrary, its irregularities of surface, up to the Adamite epoch, had always been such as to justify its being described as without form — then (as stated at p. 58) the animals and vegetables, which geologists refer to distinct periods of time, as so many successive creations — each creation following the destruction of the preceding races, — then, we say, all these races may have existed contemporaneously. All varieties of temperature, from intense heat to intense cold, may have been found in the various deep and elevated localities of the shapeless surface. And it must be borne in mind, that by thus taking Moses's word that the earth was without form, we do not deprive geology of its long pre-Adamite period — only of its nine-and-twenty successive creations — each an *improvement* upon the preceding creation, up to the creation of man, 'the crowning-point of all.'

The entire surface of the pre-Adamite earth being thus tenanted, if the cohesive force of the more protuberant parts of the solid materials were relaxed, the loosened matter would arrange

itself into a globular, or nearly globular form; and 'the waters' would cover its surface. In such a dissolution of the component parts of the solid eminences, and their arrangement forthwith, under the law of gravitation, into a sphere, animal and vegetable remains would be found, for the most part, in the soils they had occupied when living; but which soils, in a disintegrated state, would now have spread themselves out in successive layers. And there is no physical necessity that these layers should be more and more dense, or that their specific gravity should increase, the lower they lie; although such ought to be the arrangement of material, if the mass of the earth had been in a state of liquid fusion. Observation, however, declares against such a uniform disposition of strata, the heavier matter being frequently found above the lighter. And not only so, but organic remains are frequently found in strata where, according to the igneous theory, and the consequent progressive stages of animal organisation, they could not have been expected to have existed; in fact, where they ought not to be. Geological discovery has, year after year, shown the small value of negative facts. It has been over and over again proved, that men's inability to find the remains of higher organisms in earlier strata was due, not to the absence of such remains, but to incomplete examination.

At p. 460 of his *Manual of Elementary Geology*, Sir Charles Lyell gives a list in illustration of this. It appears that in 1709 fishes were not known lower than the Permian system. In 1793 they were found in the subjacent Carboniferous system; in 1828, in the Devonian; in 1840, in the Upper Silurian. Of reptiles, it appears that in 1710, the lowest known were in the Permian; in 1844, they were detected in the Carboniferous; and in 1852, in the Upper Devonian. While of the mammalia, it seems that though in 1798 none had been discovered below the Middle Eocene, in 1818, they were discovered in the Lower Oolite; and in 1847, in the Upper Trias.

Since this list was made out, the case of the Uniformitarians has been strengthened by Professor Huxley's demonstration, that the staganolepis of the uppermost Devonian beds was a teleosaurian reptile, a reptile of high organisation, nearly allied to the existing crocodile; whence it appears that an animal standing nearly at the head of the second great division of the vertebrata, dates back to the middle of the palæozoic period.*

In reference to the received geological theories, these are singular and irreconcileable anomalies; but taking Moses's description of the original

* 'Illogical Geology,' p. 81. *Universal Review*, 1859.

shapeless figure of the earth as a truthful description, and regarding its irregular surface, with all its organic remains, to have been moulded into form as suggested above, what are here anomalies become phenomena naturally to be expected.

Verse 3. 'AND GOD SAID, LET THERE BE LIGHT; AND THERE WAS LIGHT.' We have already seen that the *material* of light, the luminiferous ether, or heaven, was created *in the beginning*; and, from the existence of seeing animals prior to the Adamite period, that this material must then have performed its peculiar office, and have produced light up to the time when, from the earth having become desolate and void, all further supply would have been but waste of energy. The command, therefore, 'Let there be light,' amounted to this:—let the already existent, but dormant or quiescent ether, resume its function, awake into activity, and again, by its undulations, dispel the darkness. As already remarked, it is deserving of special notice that the inspired writer does not say, and God *made* light; the material was already there. The command was simply that it should no longer continue in repose, but should perform the office for which it was created; that the suspended undulations should become again active. It was not *matter* that was here spoken into existence, but *motion*.*

* 'It appears highly probable, from recent discoveries, that

We have certainly no right to assume that there was more of this motion, or more even of the material of light, than sufficed for the earth's need. 'In the beginning,' for aught we know to the contrary, the *whole* of the ether, enveloping the motionless and shapeless mass, might have been created in a state of activity: there might *then* have been no night. The intensity of this continuous light was probably not very great: it may have been little more than what we should now call twilight. There is some reason for this supposition. Geologists have specially noticed the great size of the eyes of certain of the pre-Adamite animals—a fact that would imply a corresponding faintness of light. Thus, speaking of the reptiles called ichthyosauri, Professor Buckland remarks: 'They approach nearest to crocodiles in the form and arrangement of their teeth.

light is not a material substance, but only an effect of undulations of ether; that this infinitely subtile and elastic ether pervades all space, and even the interior of all bodies: so long as it remains at rest, there is total darkness; when it is put into a peculiar state of vibration, the sensation of light is produced: this vibration may be excited by various causes: e. g. by the sun, by the stars, by electricity, combustion, &c. If then light be not a substance, but only a series of vibrations of ether, i. e. an effect produced on a subtile fluid by the excitement of one or many extraneous causes, it can hardly be said, nor is it said in Gen. i. 3, to have been *created*, though it may be literally said to be called into action.' (Buckland, vol. i. p. 28.) [The above note from Dr. Buckland would have appeared in the former edition of the present essay, if the author had been aware of its existence.]

The position of the nostril is not, as in crocodiles, near the point of the snout; it is set, as in lizards, near the anterior angle of the orbit of the eye. The most extraordinary feature of the head is the enormous magnitude of the eye, very much exceeding that of any living animal.' * Again, in describing the flying saurians, the pterodactyles, he says, 'Their eyes were of enormous size, apparently enabling them to fly by night.' † But, as stated above, we have nothing to justify the hypothesis, that in the pre-Adamite world there was any night at all; but that the subsequent alternations of light and darkness, day and night, were, as now, the consequences of the rotation afterwards communicated to the earth. The primitive light was not sun-light, and was most likely much less brilliant, the deficiency in intensity being compensated by the superior powers of vision of the then living inhabitants. The alternations of day and night, though always attendant upon the earth's rotation, were in the first instance produced by the direct agency of Omnipotence, without the intervention of any *physical* cause, as is clearly declared in the fourth verse; before considering which, however, we shall here add a few additional remarks in support of the modern scientific doctrine, that the material of light is a

* Buckland, vol. i. p. 168. † Ibid. p. 218.

subtile and elastic fluid, which exists quite independently of the sun.

It is found that, just as certain phenomena of optics demand for their satisfactory explanation a vehicle for light (the luminiferous ether), so certain phenomena of astronomy demand for *their* satisfactory explanation the existence of a subtile fluid such as this luminiferous ether is conceived to be. Professor Encke, in his *Dissertation on the Comet* which bears his name, though he himself modestly calls it Pons' comet, writes thus: —

'If I may be permitted to express my opinion on a subject which for twelve years has incessantly occupied me, and in treating which I have avoided no method, however circuitous, no kind of verification, in order to reach the truth as near as lay in my power, I cannot consider it otherwise than completely established, that an extraordinary correction is necessary for Pons' comet; and equally certain is it, that the principal part of it consists in an increase of the mean motion proportionate to the time. Another question, which is properly more physical than astronomical, is this, whether the hypothesis of a *resisting medium* gives the true or probable explanation, though *hitherto no other appears to me to have equal weight.*' (Airy's translation of *Encke's Dissertation on the Comet*, 1832.) The Astronomer Royal (Airy) himself remarks: 'Encke has stated that his hypothesis,

which represents all the later observations within a few seconds, does also represent the earlier observations within about eight minutes, and a part of this he thinks due to the inaccurate calculations of perturbation. Consequently, *the supposition of no resistance must be enormously in error, for some of the appearances; and there can, therefore, scarcely be a doubt that the hypothesis of a resisting medium, or something which produces almost exactly the same effects, is the true one.*' We need scarcely add, that this 'resisting medium' is regarded by the most eminent cultivators of modern science as identical with the luminiferous ether, the existence of which as a physical *reality*, and not merely as a physical hypothesis, thus finds unlooked-for support from a department of science quite distinct from the science of light and optics.

Verse 4. 'AND GOD SAW THE LIGHT, THAT IT WAS GOOD: AND GOD DIVIDED THE LIGHT FROM THE DARKNESS.'

Verse 5. 'AND GOD CALLED THE LIGHT DAY, AND THE DARKNESS HE CALLED NIGHT. AND THE EVENING AND THE MORNING WERE THE FIRST DAY.'

The division of the light from the darkness is expressly described, in the first of these verses, as a *distinct act* of Almighty power, as, in the absence of the sun, it undoubtedly must have been. Previously to the creation of that luminary, the

alternation of day and night could have taken place in no way intelligible to us except in consequence of one portion of the rotating earth's ethereal envelope being kept in a state of quiescence, and the other portion in a state of undulatory agitation. It is most probable that the command, 'Let there be light,' in the preceding verse, was allowed to operate only on so much of the surrounding ether as was intended to produce day; and God accordingly prescribes and fixes the boundary across which no undulations were to pass, thus, by His immediate control, dividing the light from the darkness. If, as now, the *sun* had been the exciting cause of light, the division of the light from the darkness would at once have taken place, and could not have been correctly described as a distinct manifestation of Almighty power. The sun being the agent, the darkness of any one portion of the earth is necessarily simultaneous with the illumination of the opposite portion — the antipodes. But the sun had not as yet been created; and during the non-existence of this physical cause of the ethereal undulations, Moses, as if to silence crude speculation on the matter, authoritatively, and in the plainest terms, ascribes the separation of light and darkness to the direct putting forth of Omnipotent power, thus precluding the notion that the effect was produced through the intervention of any material agency whatever.

In reference to the second clause of the fifth verse, 'And the evening and the morning were the first *day*,' much controversy has arisen. In order to accommodate its meaning to prevailing geological theories, the term 'day' has been conceived to signify, not a period of about twenty-four hours, but some indefinite interval of time —an interval that may have embraced thousands or millions of years—a view of the term that looks very like coaxing scripture into an unwilling compliance with a physical hypothesis.* We cannot but regard the 'six days' of creation to be what they are implicitly declared to be, periods of time equivalent to those periods described in the twentieth chapter of Exodus, in precisely the same words, 'Six days shalt thou labour.'

The geological doctrine of the Mosaic day, embracing thousands of years, has been thought to receive countenance and support from the oft-quoted declaration of St. Peter, that 'one day is with the Lord as a thousand years, and a thousand years as one day;' as, also, from the fourth verse of the second chapter of Genesis, namely, 'These are the generations of the heavens and of the earth when they were created, in the day that the Lord God made the earth and the heavens.'

* We here allude to the views of Hugh Miller, in his *Testimony of the Rocks.*

But it is pretty clear here that the writer, whether Moses or not, uses the language 'in the day,' as synonymous with the expression, 'at the time,' or 'when,' just as the same phraseology is used now. No one could mistake the meaning intended to be conveyed, if a person were to say that our naval armaments now are very different from what they were in Nelson's day. It is not likely that Moses would have so distinctly characterised each of the creative periods as a *day*, and that then either he or any subsequent writer, in referring to and epitomising the narrative of the first chapter, would have afterwards meant by *a day* the aggregate of all the six days. And whatever might have been the extent of each individual period, this would have been equally inconsistent and contradictory.*

In the passage from St. Peter (2 Pet. iii. 8), the apostle seems to admonish us against a wrong understanding of the truth he is about to declare:

* Many biblical scholars, and among them the learned Dr. Davidson, ascribe the second chapter of Genesis rather to Ezra than to Moses; but whoever was the writer, the *writing*, as respects the earlier verses, is evidently only a summary of the more circumstantial narrative in the first chapter, so that the same word could not have been employed in two different senses.

Professor Rawlinson remarks (*Aids to Faith*, p. 251): 'It is not intended to deny that the Pentateuch may have undergone an authoritative revision by Ezra, when the language may have been to some extent modernised, and a certain number of parenthetic insertions may have been made into the text.'

'Be not ignorant of this one thing, that one day is with the Lord as a thousand years, and a thousand years as one day.' In other words, be not ignorant that *time is no element of consideration with God.* It is true, that the creation was the work of six days; but every reader of the narrative sees that that work was intermittent, not continuous. No one can suppose that the work of any one day fully occupied and exhausted that day, any more than he can suppose the resting on the seventh day to mean repose after fatigue, instead of simply cessation from work. There is nothing in the Mosaic account to imply the occupation of *time* in any of the creative acts — and *acts* they in strictness were, not *operations*; we never find any allusion to a *process* — anything indicative of a germ, a development, a consummation. There are no such progressive stages as, 'first the blade, then the ear, after that the full corn in the ear.' No: — 'the Lord God made the earth and the heavens, and every plant of the field *before it grew.*'

The rounded and rotating earth having been endowed with its material properties, and supplied with its dynamic laws, having, as it were, received its commission, was suffered, without impediment, to obey that commission, to roll on, and complete its day, before any creative fiat again went forth.

Verse 6. 'AND GOD SAID, LET THERE BE A FIRMAMENT IN THE MIDST OF THE WATERS, AND LET IT DIVIDE THE WATERS FROM THE WATERS.'

Verse 7. 'AND GOD MADE THE FIRMAMENT, AND DIVIDED THE WATERS WHICH WERE UNDER THE FIRMAMENT FROM THE WATERS WHICH WERE ABOVE THE FIRMAMENT: AND IT WAS SO.'

Verse 8. 'AND GOD CALLED THE FIRMAMENT HEAVEN. AND THE EVENING AND THE MORNING WERE THE SECOND DAY.'

In the sixth verse it is recorded that God said, 'Let there *be* a firmament,' and in the seventh, it is declared that 'God *made* the firmament.' Here then is another distinct act of material creation. What the firmament was we are told in the eighth verse: 'And God called the firmament heaven.' There was thus introduced an extension of the original heaven, that is, of what for distinction's sake may be appropriately called the *terrestrial heaven*; and the remote expanse beyond—the destined regions of the sun, moon and stars—was now furnished for the reception of those bodies—supplied with the *material* on which they were to act: in other words, the *sidereal heaven* was now brought into existence.* These ethereal regions, extending as far, at least, as the remotest of the contemplated stars, constituted the firma-

* This subject will be considered under a somewhat different point of view in Section VI.

ment, which, we are told, 'divided the waters which were under it from the waters which were above it.' As science has no access to what may be *above* the firmament, no man is competent to say that aqueous matter may not be there as well as below the firmament.

Up to this point the only heaven in existence was the earth's heaven; this terrestrial heaven need not have exceeded more than a few miles in extent; it was created 'in the beginning' to illumine the earth, and to do this independently of the agency of any remote luminous body, and no more of the luminiferous matter was supplied than sufficed for this purpose. What would have been the use of the firmament, or sidereal heaven, ages before the physical agents destined to act upon it were called into existence? It would have been as useless as would have been these agents themselves, for the purposes of light, without the ether — without the very material out of which alone they could educe this light. The firmament being but now created, sufficiently indicates that up to this period the sun and moon are non-existent.

But there has been a good deal of controversy, especially of late, as to what Moses really means by the term *firmament*. By some it is maintained that the atmosphere is signified, or rather so much of this fluid as is between the earth and the clouds, and by which the waters under it are divided from

the clouds — the waters above it. But Moses distinctly declares that it is in this region that the sun and moon are afterwards placed. And, leaving inspiration altogether out of the question, it is impossible that, even as a mere man, Moses could ever have supposed that the sun and moon were situated below the clouds, by which he must have so often observed these luminaries to have been obscured and hidden. He himself declares them to have been set not merely in the heaven, but 'in the firmament of the heaven' — that region of it which is above and beyond the limited terrestrial heaven of the 'beginning.' Everybody knows now that these bodies are placed above the clouds — everybody, in all preceding ages, whatever may have been the prevailing system of astronomy, equally knew this: can we suppose that, of all mankind, Moses was the only person who imagined the very opposite, without at the same time supposing him to have been an idiot?*

The waters above the firmament must therefore imply something very different from the clouds; but whether the firmament or sidereal heavens really have a boundary, whether anything material exists beyond, and if so, *what*, are points beyond the reach of science to determine. Yet even upon these science is not entirely silent. Lord Rosse's

* 'With clouds he covereth the light; and commandeth it not to shine by the cloud that cometh betwixt.'—Job xxxvi. 32.

great telescope has penetrated even the densely crowded Milky Way, has reached its confines, and has discovered *beyond* 'a perfectly black ground;' a very remarkable circumstance when viewed in connection with the inspired declaration respecting 'waters above the firmament.' Is it not possible that above this 'black ground'—this dark and starless stratum, there may be another and *totally distinct* region of light—a *third heaven*?

And we would further ask (putting the inquiry with great diffidence), may not a literal interpretation be thus given to the remarkable declaration of St. Paul,—'I knew a man . . . . caught up in the *third heaven*'? At all events, the distinct recognition in scripture of a 'third heaven,' lends countenance and support to the views developed in the preceding pages as to the *two* heavens, the terrestrial heaven and the sidereal heaven, the only heavens with which, in his mortal state, man has to do, and the only heavens which the Bible declares 'shall pass away.' It is the first of these heavens that He 'covereth with clouds' (Psalm cxlvii. 8); it is the second in which the 'two great lights' are set; but it is the third of which Jehovah Himself speaks when He says to Moses, 'Ye have seen that I have talked with you from heaven' (Exod. xx. 22).

Many passages throughout the Scriptures, which otherwise would appear obscure and confused,

become clear and intelligible by regarding 'the heavens'* as expressive of one or other (or, at most, of the created *two*) of three distinct regions of light. The abode of Deity—'Thy dwelling-place'—cannot surely mean a habitation below the clouds. No inspired writer, no writer whatever, could at any time have entertained an idea so derogatory to the 'Majesty on high.' Nor can it ever be meant that this 'dwelling-place' is in the firmament, for where was it before the firmament was *made*? It must have been, and is, above and beyond all this, a separate and totally distinct region of light: 'Thou coverest Thyself with light as with a garment'—the light, not of the terrestrial or of the sidereal, but of the celestial heaven—'the third heaven.'

We may notice here that the term 'firmament,' by which the Hebrew word has been translated, is not so inappropriate a term as objectors have imagined. If there be any one thing in the whole of material creation which is permanent in situation, firmly and immoveably continuing ever in the same place, that thing is the ethereal fluid to which the term is applied. What we call its *motion* is mere vibratory agitation, without any bodily translation of material. There is not the slightest reason to suppose, from anything that

* In the original Hebrew, this term is always in the plural: it has no singular.

science makes known respecting it, that the great body of the ether in which all the heavenly luminaries are placed—the firmament—has ever stirred from the position in which the Creator at first placed it.* Look, too, at the most ordinary phenomena of light. It is never blown about by the winds, or in the least agitated by atmospheric commotions; for in the most violent storm we see the shadow of an unmoving object remaining itself still unmoved. Light pursues its course unaffected by these surrounding disturbances, and what would prostrate even the firmest oak cannot so much as bend aside the slenderest sun-beam.

In reference, then, to this peculiarity, and to its permanent immobility as a whole, is there anything absurd, or even inappropriate, in calling it the *firmament*. In reference to its vibratory lustre, is there anything absurd in comparing it to a 'molten metal mirror'? And in reference to its fineness, its tenuity, and its tremulousness, is there anything absurd in comparing it to a delicate 'curtain'?

The reasons given above to justify the propriety of the term *firmament*, as applied to the celestial expanse, are not pretended to be those which prevailed with the SEVENTY when they translated the Hebrew word for this expanse by

* This could not be said of the original *terrestrial* heaven, which, after rotation had been impressed upon the rounded earth, accompanied the earth in its progressive motion, as the atmosphere does now; but without any rotation.

the Greek word *stereoma.* The translators were not inspired men; they knew very well that the Hebrew term designated the region in which the heavenly bodies were placed; and since, in their own day, there were prevalent certain philosophical convictions as to the physical character of this region, they very naturally employed that Greek word in their translation which best accorded with those scientific convictions. All Hebrew scholars agree that the original word conveys no idea of solidity; the Greek substitute for it does convey such an idea; the original implies nothing at all as to the material or physical constitution of the firmament; and the translators, no doubt, aimed at rendering more definite what they regarded as vague and indefinite; not considering that this very indefiniteness was a mark of far-seeing wisdom.

The sacred text merely tells us that an expanded *something* was prepared for the reception of the heavenly bodies. What this something is science may find out or not, as it best can. Revelation has nothing to do with *that*; but it authoritatively declares to us — and this declaration, be it observed, is its sole object — that whatever science *conjectures* it to be, or whatever science *proves* it to be, it was made by God. For its own errors science itself must be answerable, not scripture.

Suppose that a hundred and fifty or sixty years ago an ancient and important manuscript had been discovered, in which there was an incidental allusion to light in such a passage as this: 'The light impinged on the surface;' and suppose that a translator of the day had rendered this passage thus: 'The particles of light impinged on the surface,' which, as a Newtonian, he would have been very likely to do: — would a critic of the present time be justified in affirming, on the strength of this translation, that the original writer was an advocate of the corpuscular theory of light? Is it not plain, on the contrary, that the original passage conveys not the slightest hint of any physical theory whatever? And as little of physical theory or physical fact is there in the Mosaic account of the firmament.

What scientific objectors have to prove is, not that the firmament is solid or unsolid, air or ether; but that it is *not* an expanse; that it is *not* something extended; that it is *not* something diffused or 'spread out.' When this is done, science may justly claim, in this particular, a triumph over scripture; but assuredly not before; since about the physical constitution of the firmament scripture tells us no more than it does about the physical constitution of the sun and moon, which is just *nothing*. Science, it is true, has enlightened us a little upon this matter, and the

sole object of the remarks made above, upon the old word 'firmament,' is to show that, notwithstanding our modern knowledge of the thing itself, that term may still be applied to it, without that violation of scientific propriety which has been alleged.

It is scarcely worth while to notice here at any length the interpretation which Mr. Goodwin gives of 'the opening chapter of Genesis.' He says that 'It represents the sky as a *watery vault*, in which the sun, moon and stars are set;' though in another part of his Essay he says (inconsistently enough) that 'the Hebrews understood the sky, firmament, or heaven, to be a permanent *solid vault*,' in which the sun, moon and stars are set — printing the word 'set' in italics, as if to imply their fixedness in a solid substance. But even science employs similar language, frequently speaking of celestial objects as if they were projected on the background of the heavens: thus, the late Sir William Herschel, in detailing his observations on Nebulæ, says: 'One of these nebulous beds is so rich, that, in passing through a section of it, in the time of only thirty-six minutes, I detected no less than thirty-one nebulæ, all distinctly visible *upon a fine blue sky*.'* And we submit that, if mere verbal criticism is to be indulged in, in a matter of this

* *Philosophical Transactions*, 1784, p. 442.

kind, there is *less* scientific precision in Herschel's terms 'visible *upon*,' than in Moses's terms 'set *in*,' which obviously mean *placed in*.*

The firmament, or fixed and immovable sidereal heavens, having now been created, and the rotation of the earth, as well as its rectilinear progressive motion, still continuing — 'the evening and the morning were the second day.'

Verse 9. 'AND GOD SAID, LET THE WATERS UNDER THE HEAVEN BE GATHERED TOGETHER UNTO ONE PLACE, AND LET THE DRY LAND APPEAR: AND IT WAS SO.'

Verse 10. 'AND GOD CALLED THE DRY LAND EARTH; AND THE GATHERING TOGETHER OF THE WATERS CALLED HE SEAS: AND GOD SAW THAT IT WAS GOOD.'

Till we come to this ninth verse, there is no mention of anything *appearing* at the surface of the globe but *waters*. When a shapeless mass has been converted into a sphere, the original matter will be comprehended under a less extent of surface; and if, as geologists infer, sea was more prevalent than land on the pre-Adamite earth, the rounded mass would become uniformly covered with a continuous *deep* sea. This was the condition of the earth up to the close of the

* For an examination of Mr. Goodwin's comments upon the Hebrew word for 'firmament,' and a proof of their fallacy, the reader is referred to the Rev. Dr. McCaul's Essay, in *Aids to Faith*.

second day; but now the Deity commands, not the separation of the waters from the land, but the *emergence* of the land from the waters—'let the dry land *appear*.' There were thus such upheavals of the earthy crust in some parts and depressions of it in other places as sufficed to produce the *necessary* degree of ruggedness to the dry land, and the requisite receptacles for the waters — the 'seas.'

That a certain degree of ruggedness *was* necessary is obvious. Without such there could be no rivers or fertilising streams, nor yet that climatic variety, so beneficial to the health and comfort of man, which even a very limited region often presents; the region of the Himalayas, for instance, and, in fact, that of most mountainous countries in the torrid zone — the zone where the highest mountains in the world are placed; those next in height being found in the temperate zones.*

As Buffon eloquently and justly remarks, 'The irregularities which are on the surface of

* 'The high table-land of Mexico is strongly illustrative of the effect of mere elevation. The traveller who disembarks first on the Atlantic coast, and wanders inland, soon finds himself amidst all the luxuriance of a tropical forest, and surrounded by all the dangers of tropical existence. Still wending his way inland, he ascends a mountain elevation, and finds himself suddenly transported to a region where, on account of its elevation, the climate is totally changed, and with it the vegetation. So marked is the change, that the high table-land of Mexico is well adapted to the growth of wheat, which refuses to grow anywhere in tropical lowlands.'—Scoffern's *Meteorology*.

the earth, and which might be regarded as imperfections of figure, are necessary to preserve vegetation and life on the terrestrial globe. To be assured of this, it is only requisite to conceive what the earth would be if it were even and regular. Instead of delightful hills from whence pure streams of waters flow to support the verdure of the earth, instead of those rich and flourishing meadows where plants and animals agreeably find subsistence, a dismal sea would cover the whole globe, and the earth, deprived of its valuable qualities, would remain but an obscure and forsaken planet, destined, at best, only for the abode of fishes.'

Verse 11. 'AND GOD SAID, LET THE EARTH BRING FORTH GRASS, THE HERB YIELDING SEED, AND THE FRUIT TREE YIELDING FRUIT AFTER HIS KIND, WHOSE SEED IS IN ITSELF, UPON THE EARTH: AND IT WAS SO.'

Verse 12. 'AND THE EARTH BROUGHT FORTH GRASS, AND HERB YIELDING SEED AFTER HIS KIND, AND THE TREE YIELDING FRUIT, WHOSE SEED WAS IN ITSELF, AFTER HIS KIND: AND GOD SAW THAT IT WAS GOOD.'

Verse 13. 'AND THE EVENING AND THE MORNING WERE THE THIRD DAY.'

The command, 'Let the earth bring forth,' &c., is similar to the command, 'Let the dry land appear.' In both cases it is added, 'and it was so.' Hence, as in the one case there was an immediate uprising of the land, so in the other there was an instantaneous springing up of vegetation upon it,

'the earth brought forth grass,' &c., without the slow process of growing; there was no natural developement from seed, the tree was *made* with the seed for propagation 'in itself:' as stated more explicitly in the second chapter, 'God made every plant of the field before it was in the earth, and every herb of the field before it grew;' His WILL commanded its existence before it shot forth from the earth that was henceforward to sustain and nourish it. It was not a rapid *growth*, under a hot moist and stimulating soil; in the eleventh verse, as well as in that from the second chapter, just quoted, we are warned, as it were, against this conclusion; for no sooner does the fiat go forth, 'Let the earth bring forth' (what already prepared was in its soil), than 'it was so.' There is thus excluded all pretext for any hypothesis about 'spontaneous production or generation.' The trees came forth from the earth solely at the bidding of their Creator, not perhaps in full maturity and covered with foliage; the branches and leaves and fruits may have spread out and unfolded themselves, and expanded under the *natural* influence of a suitable temperature, in even a few days' growth; but all these were in the tree itself *before* it grew, and when it was *made*: 'He commanded, and they were created' (Psalm cxlviii. 5).

We have already noticed (p. 95), that nothing is more distinctly implied, throughout the entire

narrative of God's creative acts, than the fact that they were quite independent of time in the performance of them. From the inadequacy of human language we have repeatedly designated them as *operations*; but as an operation implies time, the term is not strictly appropriate. And herein consists the characteristic distinction between the 'works' of Deity and the processes of Nature — between the Creator and the creature: the former *acts*, the latter *operates*; with God time is nothing, with Nature it is everything — it is the indispensable tool by the use of which all her results are accomplished.

The dry land having been thus prepared for the occupation of man, and furnished with that vegetable supply that was necessary for his sustenance, and the rotation of the earth still continuing, 'the evening and the morning were the third day.'

Verse 14. 'AND GOD SAID, LET THERE BE LIGHTS IN THE FIRMAMENT OF THE HEAVEN, TO DIVIDE THE DAY FROM THE NIGHT; AND LET THEM BE FOR SIGNS, AND FOR SEASONS, AND FOR DAYS, AND FOR YEARS.'

Verse 15. 'AND LET THEM BE FOR LIGHTS IN THE FIRMAMENT OF THE HEAVEN, TO GIVE LIGHT UPON THE EARTH; AND IT WAS SO.'

Verse 16. 'AND GOD MADE TWO GREAT LIGHTS; THE GREATER LIGHT TO RULE THE DAY, AND THE LESSER LIGHT TO RULE THE NIGHT: HE MADE THE STARS ALSO.'

Verse 17. 'AND GOD SET THEM IN THE FIRMAMENT OF THE HEAVEN, TO GIVE LIGHT UPON THE EARTH.'

Verse 18. 'AND TO RULE OVER THE DAY, AND OVER THE NIGHT, AND TO DIVIDE THE LIGHT FROM THE DARKNESS: AND GOD SAW THAT IT WAS GOOD.'

Verse 19. 'AND THE EVENING AND THE MORNING WERE THE FOURTH DAY.'

The whole of the *created* heaven extends from the surface of the earth to the remotest bounds of the sidereal system; and sometimes, in scripture, the term heaven or heavens is employed in this comprehensive sense; but the expression, 'firmament of the heaven,' always means that remote and more voluminous portion of this whole, by which the terrestrial heaven was increased, or rather encompassed on (*perhaps*) the second day, and in which the sun, moon and stars are placed; that distinct region of the ethereal fluid which was then expressly created for the reception of those luminaries.

We are told above that the 'two great lights' were made to give light upon the earth, and to divide the light from the darkness; that is, they were now created to effect that which, up to this period, had been accomplished without their intervention. *How* accomplished, without the physical agency of the sun, man can never know. He does not know even how light is produced

with that agency. He cannot tell how it happens that the presence of what is called a luminous body should instantaneously throw the subtile matter called the ether into a state of such extraordinary agitation, that it pulsates on the average at the rate of at least five hundred millions of millions of times in a second, as calculation shows it must do. The phenomena of light are not a whit more incomprehensible when produced by the direct fiat of Omnipotence, without any intermediate physical agent at all, than when produced by the intervention of *something* expressly created for the purpose.

Nevertheless, when this physical something *is* created, it is but reasonable to expect that additional functions would be assigned to it, over and above the office of keeping up what had hitherto gone on without it. Previously to the creation of the sun, the earth had performed three diurnal rotations, and during all this time had been advancing forward, with a uniform motion, in a rectilinear direction. But the Creator now sees fit to check this onward motion, and to compel the earth henceforth to describe, not a straight line, but *an orbit*; and the physical agent that diffuses over it light and heat, and that produces its alternations of day and night, is also at the same time delegated, by its attractive agency, to control this progressive motion, and to prescribe to the earth its orbital path.

Whatever were the supernatural means (if *means*, in the ordinary sense, at all there were) by which, during the three first days of the creative week, the light of day was sustained, and the line marked which forbade its intrenching upon the darkness — dividing the day from the night — they were now withdrawn, and the sun poured forth its beams. For the first time, the firmamental ether sprung into activity by *their* agency, and what the mind of man always grasps after, a *physical cause*, was now furnished forth — an object to excite his admiration and to exercise his intellect throughout all future ages. 'The evening and the morning' of the fourth day were the first of those evenings and mornings in the long series which has extended up to the present moment, and which is destined to continue till time shall be no more.

The statement, 'He made the stars also,' may have been what it seems to be, parenthetical — a piece of supplementary information which, in a modern work, would have been put in a foot-note. (See the note at p. 94.) Yet, if *some* only of the stars were made on the fourth day, the others — the *fixed* stars — having been made previously, we can conceive no better way of recording the fact, in the brief compass of five words (in the original of only *three* words — 'the stars also'), and at the same time avoiding chronological

inaccuracy. It will occur to the attentive reader that there is one day's work the result of which is not recorded to have been applied immediately to its mainly intended purpose — this purpose being postponed for a whole day. In fact, it would at first sight seem that this day's work was premature — performed before it was absolutely wanted, and kept standing, as it were, in a condition of uselessness, through an entire day, for lack of means to execute its principal functions: we allude to the work of the second day, the creation of the firmament. No lights are *stated* to have been set in the firmament till the *fourth* day — a circumstance strikingly out of keeping with the systematic and orderly succession of events so conspicuous in all the other parts of the descriptive narrative. But the parenthetical clause above removes the apparent discrepancy, and suggests the inference that the *fixed* stars were supplied to the firmament when it was made, on the second day; and the *wandering* stars, the planets, with the sun and moon, on the fourth day. The fixed stars are wholly independent of our sun — they do not want it; and *their* introduction into the firmament was therefore, probably, immediate: but the planets were not set there till the body which was to overrule their motions had been prepared.

We submit that, looking at the peculiar form of

the parenthetical expression — no indication as to a particular *day* being given — and looking also at its peculiar position in the narrative, that the foregoing are reasonable inferences. And if so — regarding the words 'He made the stars also,' as if they were in parentheses, or in a foot-note, then in the following sentence, 'And God set them in the firmament of the heaven to give light upon the earth,' the 'them' will refer exclusively to the sun and moon, as the objects so placed to *give light upon the earth*. Many stars are visible only through a telescope.

It has been *supposed*, however, that there are fixed stars the light of which has been tens of thousands of years in reaching the earth — stars which must, therefore, have been created long before Adam. We shall consider this conjecture in Section VI., which is supplementary to this.

Verse 20. 'AND GOD SAID, LET THE WATERS BRING FORTH ABUNDANTLY THE MOVING CREATURE THAT HATH LIFE, AND FOWL THAT MAY FLY ABOVE THE EARTH IN THE OPEN FIRMAMENT OF HEAVEN.'

In these words we have recorded the work of the fifth day — the first bringing forth of animal life. The inhabitants of the waters were now produced, and produced in abundance; and 'the fowl of the air,' as they are called, no fewer than three times, in the subsequent verses, were at the same time created.

The words which in our translation are rendered, 'in the open firmament of heaven,' are literally in the Hebrew, 'upon the *face* of the firmament of heaven,' * which is obviously equivalent to 'in *front* of the firmament of heaven;' either form of expression being sufficiently descriptive of the limited range within which flying creatures move, and both equally implying that this range is either wholly below the firmament, or extends to but little depth into it.

It was noticed, at p. 78, that Moses makes no mention of the creation of *air* during any of the six days, nor of *wind*, for which latter word there is an exact equivalent in the Hebrew, though not for the former. There is not, however, the slightest allusion in the original, any more than in the authorised translation, to the *creation* of the fluid without which fowl could *not* 'fly above the earth;' and we therefore felt justified in the inference, that as this fluid, as also that of light, were excluded from the record of the several creations of the six days, they *both* existed *before* those six days commenced, and were in being contemporaneously with the shapeless pre-Adamite earth.

The word which our translators have rendered 'air,' in three places in the subsequent verses,

* See *Aids to Faith*, p. 222.

and in many places afterwards, where the region in which birds fly is meant, is in strictness 'heavens;' and although 'the fowl of the air' is doubtless what is meant by 'the fowl of the heavens,' yet it is to be regretted that the original was not scrupulously adhered to. The ether is that *in* which birds fly; the air is that *by* which they are enabled to do so. In other words, the heavens is the place *where* they fly; the air is the fluid *by which* alone they *can* fly. In reference to the locality, they are 'the fowl of the heavens;' in reference to the mechanism or instrumentality employed, they are 'the fowl of the air.' Both forms of expression are equally significant and unambiguous, yet we say it is to be regretted that the first form—that exclusively made use of everywhere in the original—should, in this instance and in some others, have been departed from by our translators, since in many parts of scripture serious error would arise from regarding 'the heavens' and 'the air' as convertible terms.

Everything in the first chapter of Genesis that science has been charged with opposing is comprehended, we believe, within the limits of the twenty verses now examined. This examination we have strenuously endeavoured to conduct with the utmost fairness and impartiality. We have all along tried to dismiss every consideration

touching the sacred and inspired character of the record we have been discussing, and are not conscious that we have discussed it otherwise than, in common fairness and honesty, we should have done if the document had really been the composition of some 'Hebrew Descartes' or 'early Copernicus.' The question to be decided was: Are the statements, delivered as matters of fact, respecting the origin, the order of succession of the several parts, and the completed condition of the universe, in this ancient writing, adverse to modern science, or are they not? The inquiry has been by no means exhausted in the foregoing pages; but we submit that they amply suffice to prove, to any candid searcher after the truth, whatever his own private opinions as to the inspiration of scripture may be, that *this* portion of it, at all events, so far from being adverse *to*, is in remarkable harmony *with*, what is called 'modern science.'* We shall conclude with

* It is but right, before finally closing this exposition of the Mosaic Cosmogony, to advert to what is said in the fourth verse of the second chapter: 'These are the generations of the heavens and of the earth when they were created, in the day that the Lord God made the earth and the heavens.'

The words, 'These are the *generations*,' refer to the several *productions* or results of the six days' work previously recorded, these six days being referred to 'as the time when' the Lord God *made* (that is prepared, shaped, and set in order) the earth and the heavens.

This signification of the word translated 'made' is acknowledged to be its strict meaning by all Hebrew scholars: and

giving a brief summary of what has now been said, and adding a few reflections, chiefly taken from the preceding edition of this Essay on the Mosaic Cosmogony.

RECAPITULATION AND CONCLUDING REFLECTIONS.

The following is a short summary of the principal conclusions arrived at in the foregoing Essay, which conclusions appear to us to be fairly deducible from the Mosaic narrative, read by the light of modern science:—

1. That the term 'beginning,' in the first verse of Genesis, refers to an epoch long anterior to the first of the six days.

2. That in this beginning the earth, surrounded by a luminous envelope or atmosphere, was created, the luminiferous matter being that which is

although a thing really created is frequently said, in the scriptures, to be *made*, yet a thing merely *made* (prepared, appointed, &c.) is never said to be *created*, newly produced. Whether therefore the Hebrew word translated 'made' means anything more than prepared, shaped, appointed to an office, of something already created, or whether it means, in any particular passage, 'made out of nothing,' must be gathered from the whole tenor of the passage in which it occurs: thus, in the text (2 Sam. xix. 24), 'And Mephibosheth the son of Saul came down to meet the king, and had neither dressed his feet, nor trimmed his beard.' Here the Hebrew, translated 'trimmed,' is the word for 'made.' The word is similarly used in our language, e. g. 'He made his bed.' [The author ventures upon these remarks on the authority of biblical critics].

there called 'heaven,' by modern inquirers *ether*; and that either then or at some other time during the pre-Adamite period air was also created. It either preceded or was contemporaneous with the creation of breathing animals.

3. That at the commencement of the six days the earth was without any regular figure, presenting great elevations and great depressions; that it was *probably* thus 'without form' from the beginning; and had *become* void or desolate, the light previously illuminating it having been extinguished, but the air remaining.

4. That the first modification of the earth's form was the result of that mysterious operation described as the Spirit of God moving upon the face of the waters, by which act the earth was converted into a rounded form, all its waters *consequently* spreading themselves over its surface; and at the same time the moving energy so acting as to give to the globular mass a rotatory and progressive motion, the latter being, *of course*, in a straight line.

5. That the next act was the revival of the previously-extinguished light, by a portion of the sometime quiescent ether being again called into active operation, or once more set in motion; but that limits were now assigned to this motion, beyond which limits the vibrations of ether were not to extend: that is, 'God divided the light

from the darkness,' and thus, in consequence of the rotation previously communicated to the earth, the phenomena of day and night for the first time occurred. Before the total extinction of light, there is nothing to justify the supposition that there was any darkness at all from the beginning.

6. The next act was the creation of the firmament, an extensive body of ether between the former terrestrial ether and 'the waters which were above the firmament,' to supply a suitable region and suitable material for the sun, moon and planets, in which region the *fixed* stars were *probably* at once placed; the sun, moon and planets afterwards. (See Section VI.)

This firmament being of similar material to the pre-existing terrestrial ether, is therefore called by the same name, heaven, so that there were now two distinct regions of ethereal matter — the terrestrial heaven and the sidereal heaven.

Of 'the third heaven,' 'the heaven of heavens,' the 'dwelling-place' of the Deity, where 'He covereth Himself with light as with a garment,' of this heaven nothing is said as to its *creation.* It is the heaven referred to in the words, 'Look down from Thy holy habitation, from heaven, and bless Thy people Israel' (Deut. xxvi. 15). It is the heaven referred to in the words of St. Paul: 'We know that, if our earthly house of this tabernacle were dissolved, we have a building of God,

an house not made with hands, eternal in the heavens' (2 Cor. v. 1). May we not conclude that this 'holy heaven' is also eternal, immaterial, and 'uncreate,' like the Dweller therein? And that it is only like the created heavens in so far as it is a region of light?

7. After the emergence of the land from the waters and the production of vegetation, the sun and moon were next created, and placed in the firmament to give light to the earth, &c. But as the creation of the fixed stars is mentioned only parenthetically, it is concluded (from reasons assigned at p. 113) that *they* were placed in the firmament previously, perhaps, on the second day.

8. That the work of the fourth day was the completion of the solar system; that this was the first day in which the earth was attracted from its rectilinear path, and compelled to describe an orbit; and that the alternations of day and night, as they take place now, took place then for the first time.

We may observe here, that allowing material laws to have been coexistent with, and always operating upon, matter from the beginning, as science demands, and as we *have* allowed all along, the existence of more than one planet, during the pre-Adamite period, under the conditions attributed to our planet, that is, subject to no modifications either of form or motion that would oppose

these material laws, is a physical impossibility. If one or more other planets had existed, the law of gravitation, if it had not directly contravened, would, at all events, have brought about consequences of importance quite distinct from, and independent of, those resulting from what 'God said.'

The existing motions of the solar system could not have been produced. Two or more planets brought into existence before the sun would either have coalesced into one body, or have circulated as moons to one another; so that, when the central source of attraction had afterwards been introduced, the system could not have consisted of distinct planets revolving round that centre as at present. Hence, *upon physical principles*, it was absolutely necessary that a planet like our earth, created before the sun, should remain quite isolated and alone, up to the time when the sun was introduced; any companion planets brought into existence during this interval would have marred the whole scheme of the solar system. If it be asked, why the earth should have been created first, instead of some other planet? we should reply by asking again, why that other planet should be chosen instead of the earth? But we conceive that a special reason may be assigned. It will no doubt be generally admitted that man is the most important created being in the universe; and that

his prospective creation was in view from 'the beginning.' The planet he was to occupy, therefore, and over which he was to hold dominion, required to be rendered an ample storehouse for all his future supplies, and required greater elaboration to fit it ultimately for those varied productions which minister to his equally varied wants and enjoyments. It is likely that no other planet may have needed this preparatory elaboration; and hence the reason why the earth should have so long preceded the other planets, and why indeed it should have had the precedence at all.

We close with a few reflections.

Most geologists require the earth to have been originally a boiling mass of molten matter, which for many ages must have continued useless as a habitation for organised beings, on account of the superfluous and intolerable heat. So soon as a sufficient amount of this superabundant heat had dispersed itself, by radiation, in space, comparatively insignificant organisms, those alone which were capable of enduring the still high temperature which the surface retained, were introduced. As the cooling process went on these were superseded, the land sank down and the sea-bed rose up, and tribes a grade higher in organisation made their appearance, and replaced the inferior tribes destroyed by the catastrophe. Such terrible convulsions recurred over and over again, each after

the lapse of an enormous interval of time; and thus is accounted for the geological fact that the crust of the earth, in so far as it has been explored, and which, by-the-bye, is not a hundred thousandth part of the whole, is generally found to consist of separate layers, or strata, or sedimentary formations, as they are called, in the lowermost of which strata the remains of the first creation are found; in the next, those of the second creation, and so on; although somehow or other organic remains frequently get into the wrong strata — not merely into the strata contiguous to their proper habitat when living, but into strata far below, and which must have been solidified thousands of years before the animals themselves were created! Surely only one such anomaly as this ought to be sufficient to throw serious doubts upon the truth of the molten-globe theory of the earth. (See p. 67.)

But receiving the inspired declaration of Moses, that the present rotating globe was once 'without form,' and admitting that this pre-Adamite shapeless mass abounded in luxuriant vegetation—that living creatures, of various orders and of various climatic habitats, then roamed about its surface and dwelt in its waters — where, we would ask, now that for six thousand years this once shapeless body has preserved the form into which it was then moulded—where, but at depths more or less considerable below the surface of its *present*

spherical crust, ought we to expect that the remains of these pre-Adamite existences would be found?

In the primitive condition of the earth variations of temperature must have depended solely upon distance from that internal heat which the artesian springs and the Iceland geysers show to exist now. The lower organisms would thus occupy those deep recesses of the shapeless mass where the dank warmth was best suited to their exigencies. Habitable portions of its surface might have had temperatures of which *now* we have no examples, any more than we have examples of that teeming life, animal and vegetable, and of those gigantic reptiles and huge pines, which such fertile and stimulating regions must have been fitted to nurture.

To speak of *geographical* position, in reference to any spot on the pre-Adamite earth, would be to use language which would convey no meaning. *Latitude* would be an unintelligible term; the distinction between polar and torrid regions could not have existed, for there was no *sun*; and so far from the *absence* of this body during the pre-Adamite ages creating a geological difficulty—even admitting the earth's form to have been globular—the difficulty is to account for the asserted uniformity of external temperature on the hypothesis of its *presence*.

And 'why should it be thought a thing incredible' that God should produce light, except by means of the sun, when it is admitted that He produced the sun itself without any means at all? Is not this to 'strain at a gnat and swallow a camel'? *

Even man himself, as his knowledge of natural agencies, more especially of electricity, increases, may possibly be hereafter able to do this on a small scale; that is, to fill a dark room with light, and maintain that light for a length of time, without the aid of any luminous source. This would scarcely be a more striking scientific achievement than the production of ice in a red-hot iron vessel, which has actually been accomplished, as already noticed at p. 33.

In terminating these remarks, the author must request the reader to bear in mind the single purpose for which they were penned — the purpose, namely, of showing that the 'Mosaic Cosmogony' is not so 'adverse to modern science' as it has been affirmed to be, and nothing more. The laws which it has pleased the Almighty to impress upon the matter He has created we may allowably investigate, and trace to their legitimate consequences; but *how* He created this matter,

* Who has not witnessed the brilliant illumination of the whole surrounding horizon by a flash of lightning — and that, too, at *midnight*? Where was the sun then?

or *when* He impressed upon it those laws, are questions which science cannot answer; much less can it presume to say that these same laws must have governed Omnipotence in originating the scheme, or in elaborating the details of the universe.

Nevertheless, throughout the foregoing pages we have conceded to the scientific objector the position, that matter always had the same physical properties as at present, and even that Omnipotence has never forbidden the operation of physical laws.* Without such concession, the question as to whether scripture and science are in harmony or not, could not be discussed; and, accordingly, all who have handled the matter assent to this principle. Among these are writers of the highest scientific eminence—men, of all others, the least likely to be misled into unsound arguments or false conclusions.† And although the scientific principles brought to bear upon the subject in the reasonings of one are different from those employed in the reasonings of another, yet all arrive at the same answer to the question proposed, namely, that the Mosaic Cosmogony is *not* adverse to modern science. But

* The production of light, by the fiat of the Almighty, was no violation of a physical law — any more than the production of Adam was — for the physical agent of light had not then been created.

† Professor Challis, Archdeacon Pratt, and others.

the present writer is confident that neither they, any more than himself, would ever think of regarding any of these performances as supplying the scientific deficiencies of the brief narrative of Moses, and as furnishing those circumstantial details which the inspired writer himself would have furnished if he had been commissioned to particularise more fully the successive steps of creation. The question is not, whether the details can be filled in as Moses himself would have filled them in; it is not even whether a *true* explanation of the Mosaic Cosmogony ever has, or ever will, or ever can be given; but it is this:—Can *any* explanation be given that shall satisfy at once the demands of science and the conditions of the narrative? *

If scripture and science can thus be reconciled in only *one* way, the matter is settled; but if they be shown to be reconcileable in several ways, the allegation that they cannot be reconciled at all is not only falsified, but shown to be proportionately rash and inconsiderate.

To expect, however, that *science* can unravel everything in the works or in the revealed word of the Almighty, is as presumptuous as it is absurd. Talk about the onward march of physical

* It will of course occur to every reader that the *greater* is the number of equally satisfactory explanations of any mysterious matter, the *less* is the probability that any selected one of those explanations shall be the *true* explanation.

science as we may, we well know that this march is not always a movement of progression; science is often compelled to retrace its steps, to obliterate from the chart of nature in one age much that it had mapped down in the preceding, and to take a new departure from a previously-attained stage of its course; and, succeed as we may, we must always ultimately reach a point at which human intellect is brought to a stand, and at which it is compelled to acknowledge its own infirmity and helplessness.

No one is likely to accuse the late Dr. Birkbeck of religious fanaticism; but all who remember him will admit that he was animated with the genuine spirit of an enlightened philosopher, knowing where the natural and the explicable ended, and where the supernatural and the inexplicable began. In speaking of the phenomena of vision, he thus expresses himself:—'The picture on the retina is the ultimate physical circumstance which physiologists have yet traced when vision occurs, and between that and actual sensation and perception all is darkness. We *know* that there are impressions on the retina; we *know* that in ordinary cases, when these are received, vision follows; but we *know not* how the bodily impression is connected with the mental perception; and to account for it by further impressions on the optic nerve, by impressions on

the brain, and by this being the seat of intelligence, only serves to keep our ignorance out of view, and attempts to explain the incomprehensible connection between the impression on the retina and the sensation of sight, by another equally incomprehensible connection, viz., an impression on the brain with this sensation, of which connection, however, we have no knowledge whatever.

'There is indeed in this, as in every other physical inquiry, a barrier, beyond which it is forbidden to human intellect to advance. There are, in every direction, some bounds to our knowledge, which, although they continually recede as investigation advances, can never be passed — which equally exist, though their extent is different, for the most ignorant savage and the most enlightened philosopher; and at which every man, finding himself suddenly arrested, and unable to explain the connection between certain phenomena, feels the sentiment of wonder, and is compelled to reverence a Power, the ways of which he is thus made sensible are inscrutable by a finite mind!'*

But for these shortcomings of science, there would be little or no room for the sentiment here adverted to. If everything in the Works and in the revealed Word of Deity were fully explicable

* Birkbeck's translation of Dupin's *Geometry applied to the Arts.*

by the human intellect, we could hardly render Him that intellectual homage and submission which He so justly demands, and which, as it is, we are so imperatively constrained to yield. Indeed, as respects His WORD, if the case were otherwise, it would be a misnomer to call it a *Revelation*; we might, with like propriety, call geometry a revelation. No one ever thinks of giving homage to Euclid; we never believe *him*; we receive as true just what he demonstrably proves to be true, and nothing more. Irresistible conviction must always effectually exclude faith; and such conviction is not to be had, even in the physical sciences themselves. All our individual knowledge, derived from these sciences, rests, more or less, upon a mixed basis of personal observation, reason, and faith — faith in the testimony, and in the recorded observations of others. Natural philosophers feel justified in speaking with confidence of the magnitude of the earth, of the force of its gravity, of the depths of its seas, and of the heights of its mountains. But not one of them in a thousand has ever for himself measured an arc of the meridian, or the space descended by a heavy body in a second of time — has ever sounded the Atlantic Ocean, or determined the altitude of Mont Blanc.

That genuine science will ever prove adverse to Revelation, there is no *fear*; that it will ever

penetrate its mysteries, there is no *hope*; for these are the deep and inscrutable problems of Him 'in whom are *hid* all the treasures of wisdom and knowledge' (Coloss. ii. 3.)*

* On the part of certain scientific inquirers, there is often a very inconsistent hankering after an amount of *proof* in matters of Divine Revelation, which, if furnished, would be subversive of all reverent submission to the WORD of the Deity. Proof, sufficient to justify a 'reasonable faith,' is always afforded. And the Divine Being never yielded to the desire for more, even on the part of His disciples, without accompanying the concession with marked rebuke:—'Except I shall see in his hands the print of the nails, and put my finger into the print of the nails, and thrust my hand into his side, I will not believe. . . . Then saith he to Thomas, Reach hither thy finger, and behold my hands; and reach hither thy hand, and thrust it into my side; and be not faithless, but believing. And Thomas answered and said unto him, My Lord and my God. Jesus saith unto him, Thomas, because thou hast seen me, thou hast believed: blessed are they that have not seen, and yet have believed' (John xx. 25—29).

Remission of sins is promised, unconditionally by the Saviour, to them that believe; but He always took care (so to speak) that the evidence of His Divine character furnished to the unconverted, should fall short of demonstration, and leave room for reasonable faith; otherwise forgiveness of sins would have been consequent upon mere intellectual assent to what was irresistible proof. But 'when he was alone,' with 'them that were about him,' he made disclosures of Himself which, if made to 'them that are without,' might have *compelled* belief, from the sole force of evidence addressed to their understandings, and mere intellectual perceptions; and it is in this way that we think may be interpreted the following words of our Saviour:—'Unto you it is given to know the mystery of the kingdom of God: but unto them that are without, all these things are done in parables: That seeing they may see, and not perceive; and hearing they may hear, and not understand; lest at any time they should be converted and their sins should be forgiven them' (Mark iv. 11, 12). He was

NOTE.

In the foregoing section, and in Section II. we have had frequent occasion to advert to the geological hypothesis that the earth was always a globe, or nearly so; and that originally all its materials were in a state of igneous fluidity. It is proper to add, however, that this doctrine is looked upon with suspicion, and received with misgiving, by some very competent geologists. One of the most recent of these says geology 'may guess at conditions of original igneous fluidity, or aqueous plasticity in the mass, and may hint at some great law of secular contraction; but it must be confessed, that on these and similar points science is yet unable to offer anything like the certainty of demonstration.'*

To such writers as this we would submit whether

speaking here of persons entirely without faith. Although no doubt they had witnessed His previous miracles — they wanted more *proof* — a stronger intellectual conviction; and this the Master withheld; they were not to intellectually 'perceive' and 'understand,' as a condition of their belief, more than He had already vouchsafed. Forgiveness of sins was promised 'to them that believe,' but evidence was not to be supplied to such an extent as to make belief an irresistible necessity.

* *Advanced Text-book of Geology*, by David Page, F.G.S. Third edition, p. 25.

the hypothesis that the earth, instead of being originally a molten globe, a mass of seething fluid, was originally what it is now, a body of land and water, but with a surface far more irregular — that it was endowed with internal heat, as it is now, but heat of far greater intensity — that on this surface there were lowlands sufficiently near the sources of heat to suit the organisms of the so-called first creation, and high table-lands sufficiently remote from those sources to suit the organisms of what are supposed to be the last of the pre-Adamite creations, with localities of all intermediate degrees of temperature — we would submit whether such a primitive earth would not be quite as consistent with the geological phenomena now presented by the existing earth's spherical crust, as a primitive molten fluid earth. And whether these phenomena do not follow more immediately and more naturally from this latter hypothesis than from the former, which requires so long a series of intermediate, complicated, and unaccountable operations to be gone through, before the phenomena in question could have been produced.

SECTION IV.

ON MIRACLES IN GENERAL — REMARKS ON THE ESSAYS OF HUME AND POWELL.

NO one who admits the existence of an Almighty Power, can deny the *possibility* of a miracle, without a palpable contradiction; without, in fact, affirming the proposition, that a Being may be omnipotent and not omnipotent at the same time. The inquiry as to whether a miracle be possible or not, hinges upon the previous inquiry as to whether a Power competent to perform a miracle exist or not. If the power to do any assigned thing be admitted to exist, then the possibility of that thing being actually done is also admitted. There cannot exist power or ability to do what cannot be done.

By a miracle is meant something out of the course of nature; something which the laws of nature alone are inadequate to bring about, and which therefore necessarily implies the agency of supernatural power. It is not necessary that a miracle should violate, or interrupt, or suspend

any law of nature. Any event which addresses itself to our senses, and which we know cannot result from any combination of the laws of mind or of matter, but which, on the contrary, occurs quite independently of those laws, is a miraculous event. It is inexplicable by physical science, simply because it is without the dominion of physical laws, and therefore not amenable to their authority. Such an event does not break a law of nature, because it does not come within the jurisdiction of any such law.

On the other hand, we cannot admit Omnipotent Power, and yet exclude *any* region from the sphere of its operations. A limited Omnipotence is a contradiction. If He so *will*, Omnipotence can lay hold of any part of the machinery of nature, and throw it out of gear. He *can* control or suspend its performances, whether He ever has done or will do so or not. Such an interruption of the course of nature would undoubtedly be a miracle; but there may be a special manifestation of supernatural power, without this direct interference with the operations of nature. The miracle need not consist in preventing nature from doing what it otherwise could and would do, but in introducing among its own operations a new phenomenon, something which of itself it cannot do. A new power may be antagonistic to a power already operating, and

the result be the same as if this latter were withdrawn or abrogated; but if it were actually withdrawn, then upon the new power ceasing to act, there would be required a restoration of the old, in order that the original conditions may be restored. Even in nature antagonistic forces exist: for instance, the force of gravity and the force of cohesion. If the latter did not operate against the former, a granite column could no more preserve its erect position than could a column of water; yet gravity acts upon every particle of the granite notwithstanding; but as the force of cohesion acts *also*, the result is vertical stability.

If, instead of a column of stone, we were to see a column of water so standing, we should witness a miracle; yet there would not necessarily be a violation or suspension of the law of gravity any more in the one case than in the other. Supernatural power would be acting on the particles of the water, so as to produce the same result that the natural force of cohesion produces on the stone. Any one may if he please call this a violation of a natural law, of that, namely, by which a fluid, without lateral support, tends to spread itself horizontally; but, in the case supposed, what is equivalent to lateral support is supplied; not material support, but immaterial support — *miraculous* support.

We should really think it to be a question not worth discussing, whether any specified miracle involve a direct interference with some natural operation, or whether, without such interference, it consist in the putting forth of a new power, unknown to nature, and in obedience to which matter exhibits phenomena distinct from natural phenomena. But as sceptical writers persist in prescribing the mode in which a miracle must, of necessity be performed, the presumption must be protested against. All who deny the possibility or the credibility of a miracle, take for granted that they are denying solely the possibility of a violation of the laws of nature; while, in fact, they are denying a good deal more than this. They are denying the possibility of a special manifestation of supernatural power in the material world, in any manner whatever. They will neither allow that an old law can be temporarily suspended for a special purpose, nor that a new law can be temporarily introduced for a special purpose. They broadly affirm that the Deity cannot manifest His power in an especial manner, in the material world at all. The term 'violation' is, therefore, a very inappropriate one, since there need not of necessity be any violation whatever; the word *innovation* would be far less objectionable. The real matter of controversy, however, concerns entirely the character of the

event itself, not in what way it is brought about. The question to be discussed is — Is the phenomenon really what it is declared to be or not? is it the result of supernatural agency, or of physical law? or is it a purely fabricated occurrence that never did, and never could actually happen by virtue of either?

As already observed, those who deny the possibility of a miracle, do so on the assumption that nothing ever did happen, or ever can happen, in the material world, except in obedience to the laws of matter: 'In an age of physical research like the present, all highly cultivated minds and duly advanced intellects have imbibed more or less the lessons of the inductive philosophy, and have at least in some measure learned to appreciate the grand foundation conception of universal law — to recognise the *impossibility* even of *any two material atoms* subsisting together without a determinate relation — of any action of the one on the other, whether of equilibrium or of motion, without reference to a physical cause — of any modification whatsoever in the existing conditions of material agents, unless through the invariable operation of a series of eternally impressed consequences, following in some necessary chain of orderly connection—however imperfectly known to us. So clear and indisputable, indeed, has this great truth become — so deeply seated has it been now

admitted to be, in the essential nature of sensible things, and of the external world, that not only do all philosophical inquirers adopt it, as a primary principle and guiding maxim of all their researches, but, what is most worthy of remark, minds of a less comprehensive capacity, accustomed to reason on topics of another character, and on more contracted views, have, at the present day, been constrained to evince some concession to this grand principle, even when seeming to oppose it.' The writer of this elaborate sentence then goes on to descant upon 'the universal self-sustaining and self-evolving powers which pervade all nature.' (Powell, in *Essays and Reviews*, p. 134.)

Now in all this there is really nothing that any one need hesitate to assent to, provided one all-important condition be premised. We fully admit 'the impossibility of any two material atoms subsisting together without a determinate relation,' &c., *provided they be let alone*, but not else. The above quotation, notwithstanding its laboured construction, amounts to neither more nor less than the simple statement, that matter, if left entirely to itself, must obey the laws of matter—a fact which is indisputable. But the equally palpable truth that matter must yield, not only to the laws of matter, but also to *mind*, is most strangely overlooked throughout Professor Powell's Essay. Is a steam-engine or a watch solely the

result of the action of matter upon matter? The movements of the planetary bodies are; but is it so in reference to any material construction, the work of human hands, guided by human skill?

Let a person extend his fingers, then close them, then extend them again, and so on, alternately: can any natural philosopher explain the movements thus witnessed upon purely physical principles — by referring merely to the laws of matter? Can he explain them *at all?* No; it is beyond human power to explain even so simple a phenomenon as this; and the reason why the thing is inexplicable is, that the *prime mover* is not matter, but *mind*; there is an act of *volition*, and the mechanical movements follow, and cease, and are renewed, simply because it is *willed* they should do so. We are conscious of the volition, and of the result willed forthwith taking place; but *how* mind thus coerces matter is a mystery too profound for man to fathom. Only let the 'two material atoms' adverted to in the preceding quotation be brought within the grasp of human power, and what becomes of the previous determinateness of relation between them?

When we gaze with admiration upon a stately ship — upon a complicated machine — upon a magnificent city, we gaze upon that which was once growing in the forest, embedded in the mine, or lying quiescent in the quarry. Where nature had

placed them, there would they even now be: it is mind that has brought them forth, and that has effected the transformations we contemplate. We behold not what the laws of material nature have done, but what the will of man has done. *He* has required *time* to execute what his will has determined; annihilate *that*, and we should behold a miracle.*

* A similar train of thought is carried out by Professor Mansel in his Disquisition on Miracles. He remarks (*Aids to Faith*, p. 19):—

'In the will of man we have the solitary instance of an efficient cause in the highest sense of the term, acting among and along with the physical causes of the material world, and producing results which would not have been brought about by any invariable sequence of physical causes left to their own action. We have evidence, also, of an *elasticity*, so to speak, in the constitution of nature, which permits the influence of human power on the phenomena of the world to be exercised or suspended at will without affecting the stability of the whole. We have thus a precedent for allowing the possibility of a similar interference of a higher Will on a grander scale, provided for by a similar elasticity of the matter subjected to its influence. Such interferences, whether produced by human or by superhuman will, are not contrary to the laws of matter; but neither are they the result of those laws. They are the work of an Agent who is independent of the laws, and who therefore neither obeys them nor disobeys them. If a man, of his own free will, throws a stone into the air, the motion of the stone, as soon as it has left his hand, is determined by a combination of purely material laws; partly by the attraction of the earth; partly by the resistance of the air; partly by the magnitude and direction of the force by which it was thrown. But by what *law* came it to be thrown at all? What law brought about the circumstance through which the aforesaid combination of material laws came into operation on this particular occasion and in this particular manner? The law

In all this there is no violation of material laws; there is merely a superaddition of what is quite distinct from, and external to, the laws of matter. And a miracle need be nothing more.

Those who argue, or rather those who declaim against the possibility of a miracle, must necessarily deny the existence of any such external power. A miracle can be impossible for one reason, and one reason only, namely, the non-existence of power to work one. Nobody ever pretends that nature, left to itself, ever works a miracle; in other words, that a natural phenomenon is ever at the same time a supernatural phenomenon also. Miracles can occur in nature only from some power altogether external to nature (and therefore *super*-natural) entering into nature's territories, and manifesting itself *there*. Out of nature there can be no miracle: no special manifestation of supernatural power could ever present itself to man except it take place within the region in which he himself is placed. The invariability of the laws of matter, so much insisted upon by those who

of gravitation, no doubt, remains constant and unbroken, whether the stone is lying on the ground or moving through the air; but neither the law of gravitation, nor all the laws of matter put together, could have brought about this particular result, without the interposition of the free will of the man who throws the stone. Substitute the will of God for the will of man; and the argument, which in the above instance is limited to the narrow sphere within which man's power can be exercised, becomes applicable to the whole extent of creation, and to all the phenomena which it embraces.'

deny the credibility of miracles, is the very circumstance upon which that credibility, in so far as physical considerations operate, mainly rests. Were the laws of matter variable or capricious, there would be great difficulty in discriminating between what was miraculous and what was not. Nature's undeviating constancy, so far from helping to disprove a miracle, is the very thing we should appeal to in proof that a phenomenon, inconsistent with that undeviating constancy, cannot be the result of any law of nature; but must, on the contrary, betoken the presence, at the time, of some power or energy acting quite independently of material laws, and which must therefore itself be *immaterial* and supernatural.

But the *credibility* of any affirmed miraculous event is a very different thing from the *possibility* of such an event ever taking place: without denying a thing to be possible, we may yet deny it to be credible, on the ground of the *à priori* unlikelihood of its happening, combined with deficiency of evidence that it *did* happen. Hume's position was that miracles are incredible: Powell's that miracles are impossible. The former writer took the wiser, in so far as his was the more philosophical course: he was enabled to discuss the value of testimony, and the balance of probabilities for or against, and to give something which *appears* like philosophical reasoning — however

fallacious in *reality* — in support of the principle he propounded. Professor Powell, though dealing abundantly in Hume's fallacies, takes the opposite course; what Hume ends with, Powell starts with, namely, that miracles are impossible; and thus leaves himself no room for even the semblance of argument. He nevertheless goes over much of Hume's ground in reference to the value of testimony, and discusses the question of the evidence and credibility of miracles as if he did not affirm their impossibility: we here propose briefly to examine a few of his more remarkable statements.

He says (p. 110):—'The enlarged critical and inductive study of the natural world cannot but tend powerfully to evince the inconceivableness of imagined interruptions of natural order, or supposed suspensions of the laws of matter, and of that vast series of dependent causation which constitutes the legitimate field for the investigation of science, whose constancy is the sole warrant for its generalisations, while it forms the substantial basis for the grand conclusions of natural theology. Such would be the ground on which our convictions would be regulated as to *marvellous events at the present day*; such the rules which we should apply to the *like cases narrated in ordinary history*.' [The italics are the Essay-writer's own.]

In common with all the opponents of the scripture miracles, the author of this sentence will insist

upon identifying these miracles with 'interruptions of natural order,' or 'suspensions of the laws of matter;' a position which they have not the least right to assume, and which ought not to be conceded to them. But waiving all objection on this head, we affirm that the passage involves nothing more nor less than an authoritative hypothesis; unsupported by any reasoning whatever, namely, 'the *inconceivableness* of *imagined* [sic] interruptions of natural order.' The 'inconceivableness' implies the impossibility, for the writer adds: 'But though, perhaps the more general admission at the present day of critical principles in the study of history, as well as the extension of physical knowledge, has done something to diffuse among the better-informed class more enlightened notions on this subject, taken abstractedly, yet they may still be much at a loss to apply such principles in all cases: and readily conceive that there are possible instances in which *large exceptions must be made.*' Now in a work that undertakes to show that a miracle could never be wrought, although we should be quite prepared for the absence of all sound reasoning, yet we are entitled to expect at least consistency in the authoritative statements put forth. In this passage, however, the author admits that there may be, 'among the better-informed class,' those who 'readily conceive,' what in the former paragraph

he declares to be 'inconceivable.' But it is not for the purpose merely of pointing out this contradiction that the latter quotation has been made, but for the purpose of showing that the author affirms interruptions of natural order, or suspensions of the laws of matter, to be *impossible.* And therefore, as he will have it that a miracle is nothing else than such an interruption or suspension, *a miracle is impossible.*

We cannot forbear asking here — Why did not the writer content himself with this postulate, and thus limit his Essay to a single page? *This* admitted — and he calls upon us to admit it — settles the dispute: the argument — so to misname it — commences and terminates at a single step: the beginning is the end. Miracles being, by hypothesis, impossible, what reasoning is necessary — or even applicable — to show that any specified miracle could never have been wrought?

It would have been more discreet in Professor Powell if he had narrowed the range of his postulate — if he had started with the hypothesis that interruptions of natural order or suspensions of the laws of matter were *not* impossible; and had then proceeded to show, by an examination into the credibility or incredibility of the testimony of the declared witnesses, and into the authenticity of the writings which recorded it, that the evidence in support of the affirmed 'miraculous event'

was insufficient to establish its actual occurrence. But what is the use of talking about the fallibility of human wisdom, and of 'the peculiar capacity and apprehension of the party addressed,' in reference to an event that could not possibly have taken place? If the evidence for the gospel miracles, or for any other alleged miracles is ever to be overturned or shaken by *argument*, the principle that miracles are *not* impossible must first of all be admitted, otherwise there is no room for *argument* at all.

The position that a miracle is inconceivable involves so glaring an error, that it is really inconceivable how anyone can assent to it; and whoever honestly does so must possess powers of conception limited in the extreme. Is it more difficult, for instance, to conceive a heavy body to be suspended in the air, without any physical support, than it is to conceive that, instead of remaining where it is placed, it moves towards the earth without any visible agency? We submit that, in so far as the mere conception of the phenomenon goes — in the absence of all experience — the descent of the body to the earth over whatever spot it be placed — whether here or at the antipodes, whether to the right or to the left — we say that the descent of the body, in each one of these infinitely varied directions, is more difficult to conceive than that it should not anywhere

descend at all: yet the former phenomenon results from a law of matter, the latter would be a miracle. In fact, no sensible phenomenon is inconceivable that is not self-contradictory. If anyone were to affirm that the body alluded to remained at rest and was all the while moving towards the earth, he would announce an absurdity — a thing as well supernaturally as naturally impossible, and therefore inconceivable; a thing utterly beyond the power even of a miracle.*

When, therefore, the Essayist, in confirmation of his doctrine that testimony is of no avail in reference to a miracle, quotes what he calls† 'the dictum of two great authorities of the Scottish school, Drs. Abercrombie and Chalmers, that on a certain amount of testimony we might believe any statement however improbable;' and then remarks, 'so that if a number of respectable witnesses were to concur in asseverating that, on a certain occasion, they had seen two and two make five, we should be bound to believe them' — he confounds the merely improbable with the essentially impossible — with the self-contradictory. To say that two and two are other than four, is to say that two and two are *not* two and two: and we know that no witnesses can ever have seen a thing

* The supernaturally impossible will be considered more fully towards the close of next section.

† Page 140.

to be existent and non-existent at the same time; their asseveration could not be regarded as testimony at all — it would literally amount to nothing; for it is made up of two contradictory and mutually destructive declarations — first, that they *had* seen a certain thing, and then that they *had not* seen *it*, but something else wholly different.

It is remarkable — though quite consistent with the prevailing tone of the entire Essay — that a writer who sits down professedly to discuss the possibility or credibility of the scripture miracles, as 'Evidences of Christianity,' should even dream of adducing an absurdity like this as in any respect analogous to any one of Christ's miracles. These are surely numerous enough — why not make a selection from *them*, instead of taking an imaginary case, and a case, too, which as far departs from a miracle as it does from a mathematical truth? Not a single scriptural miracle can be pointed to which is self-contradictory: such a thing would, in fact, be no miracle at all — it would be supernaturally as well as naturally impossible, like the hypothetical absurdity quoted above. And if the Essayist regard a case of this kind as coming under the denomination of a miracle, then everybody will agree with him that *such* miracles are impossible, and the declared witnesses to them idiots. We shall

quote another hypothetical example, but one of a totally different character:—

'If the most numerous ship's company were all to asseverate that they had seen a mermaid, would any rational persons at the present day believe them?'* We would further ask, would any rational persons at the present day be justified in *disbelieving* them? The hypothesis implies that there is no limit to the number of attestors. Would not rational persons, instead of summarily rejecting the evidence, be rather moved to inquire into the reported fact? What impossibility does it involve? And how would the rational persons at the present day — the rational geologists, for instance — know but that another creation was now about to be inaugurated, and that the said mermaid was merely a sample of the 'new species'? Professor Powell, at all events, if consistent, would entertain such a report in a spirit very different from that implied in the above quotation, although he would not regard the mermaid as a new *creation*; for a page or two further on he says: 'A work has now appeared by a naturalist of the most acknowledged authority, Mr. Darwin's masterly volume on *The Origin of Species* by the law of natural selection, which now substantiates, on undeniable grounds, the very prin-

* *Essays and Reviews*, p. 107.

ciple so long denounced by the first naturalists—*the origination of new species by natural causes*—a work which must soon bring about an entire revolution of opinion in favour of the grand principle of the self-evolving powers of nature.' [The italics are the Essayist's own.] Now unless mermaids were expressly excluded from these 'new species,' how could Mr. Powell turn a deaf ear to the attestations of 'the most numerous' eye-witnesses?

The Essay is full of such sweeping assertions, the very comprehensiveness of which really defeats the author's own object. If there were no limit to the number of the attesting witnesses in the case supposed above, how could there be any to question the reported fact? Where all agree, none can dissent; and Mr. Powell himself would therefore have had to testify with the others!

But in every attempt to show the impossibility or the incredibility of a miracle, the great aim is to establish one or other of these two propositions, namely:—

1. The witnesses of the alleged miracle were under a delusion, and imagined they saw what in reality did not exist; they were simply *deceived.*

2. Or, the thing witnessed was nothing but a natural phenomenon, which science, present or future, can explain on strictly physical principles.

That these are the main points which the

opponents of miracles labour to convince us of, sufficiently appears from the following quotations from Mr. Powell's Essay:—

'Questions of this kind are often perplexed for want of due attention to the laws of human thought and belief, and of due distinction in ideas and terms. The proposition, that an event may be so incredible intrinsically as to set aside any degree of testimony, in no way applies to or affects the *dishonesty* or *veracity* of that testimony, or the reality of the *impressions* on the minds of the witnesses, so far as it relates to the matter of *sensible fact* simply. It merely means this: that from the nature of our antecedent convictions, the probability of *some* kind of mistake or deception *somewhere*, though we know not *where*, is greater than the probability of the event really happening in *the way* and from the causes assigned.'

'If at the present day any very extraordinary and unaccountable fact were exhibited before the eyes of an unbiassed, educated, well-informed individual, and supposing all suspicion of imposture put out of the question, his only conclusion would be that it was something he was unable at present to explain; and if at all versed in physical studies, he would not for an instant doubt either that it was really due to some natural cause, or that if properly recorded and

examined, it would at some future time receive its explanation by the advance of discovery.'*

Now, suppose, for a moment, that we yield the first of the above positions, namely, that the witnesses were under delusion, and that we take the case of the mermaid, chosen by the Essayist himself, as an illustration of such delusion. Suppose, moreover, that the ship's company consisted of not more than ten or a dozen persons. The alleged mermaid is caught and exhibited on deck: it is handled and carefully examined by all these persons, who, trusting to the impressions on their senses, unanimously pronounce the object to be, what to all it appears to be, a mermaid. In reality, however, it is no such thing; the whole is a delusion. But that ten or twelve independent witnesses to a physical fact should *all, at the same time,* be under *the same delusion* as to what they saw and handled, and be all made to believe that they saw and handled what in reality was not in existence, is as much a miracle as any on record. The actual production of the mermaid would be no miracle at all, though Mr. Powell appears to regard it as such: the miracle would be wrought not on matter, but on mind—it would be manifested in the so-called *delusion* itself. If this be denied, let the extraordinary mental

* *Essays and Reviews*, p. 107.

phenomenon be accounted for, agreeably 'to the laws of human thought and belief.'

In reply to all this, perhaps, some one may advert to the delusions of mesmerism and electro-biology; but the present witnesses were confessedly not mesmerised by human means; so that, if at all, they must have been mesmerised by *super*human means, by the special exercise of supernatural power: the delusion, therefore, is still a miracle.

Let us take now the second position, that a so-called miracle is only a natural phenomenon which science, either now or at some future time, will be able to explain; or, putting the matter in Mr. Powell's own words, that 'the boundaries of nature exist only where our *present* knowledge places them; the discoveries of to-morrow will alter and enlarge them. The inevitable progress of research must, within a longer or shorter period, unravel all that seems most marvellous; and what is at present least understood, will become as familiarly known to the science of the future as those points which a few centuries ago were involved in equal obscurity, but are now thoroughly understood' (p. 109).

This is one of those extravagant assertions to which allusion was made at p. 152. How can any human being *know* what future science will unravel, and what it will not, even in the region of

material nature? And as to those 'most marvellous' events which the Christian regards as miracles, what has science yet done to unravel even one of them? Nothing. What ground, then, is there for the second of the preceding positions? And how does it happen that Christ never made a *mistake*, exhibiting that as a miracle which subsequent physical research has included in a law of nature? But, as before, let us admit for a moment that some, or even all of the so-called miracles of the Saviour will hereafter be explicable by advancing science. The Being who did these 'most marvellous' things was a poor carpenter's son: 'At the feet of Gamaliel' *He* never sat. His whole history shows that He neither learnt science nor taught it. How came *He* in possession of an amount of physical knowledge so vast? 'Whence hath this man this wisdom, and these mighty works? Is not this the carpenter's son?' And how is it that the combined efforts of the whole scientific world, with all its profound application and study, and with all its acknowledged great progress and success, have never been able even to approach to what He had attained to without any study or application at all? If the giving sight to the blind, hearing to the deaf, and life to the dead, be beyond the reach of physical cause and effect, they are miracles. If, on the other hand, they be due to the tran-

scendent scientific knowledge of One who never studied science at all, they are still miracles. They are thus either miracles *per se*, or works that could be performed only by a Being miraculously endowed with boundless scientific knowledge. There would, moreover, in this case be a *double* miracle wrought. There would be, first, the miraculously communicated knowledge; and, secondly, the practical manifestation of this knowledge, in the production of wonderful effects, without the aid of *tools* or *time*; successful scientific experiments, without any scientific apparatus — results without processes. Hence, even admitting the two leading atheistical assumptions, the possibility of miracles still remains an unshaken truth. Nothing, indeed, can well be more weak, or more damaging to the atheistical argument (we cannot but call it such), than the hypothesis that science may hereafter qualify even man to perform things similar to those we now call miracles. For suppose — extravagant as the supposition is — that hereafter, by aid of science, it may be possible to resuscitate a corpse: what then? Would the raising of Lazarus cease to be a miracle? would it, in the slightest degree, be regarded as *less* a miracle, after the performance of this supposed scientific experiment, than before? Certainly not; for all analogy between the two events is utterly destroyed by the very hypothesis

itself. What analogy is there between resuscitating a corpse by the help of science, and doing the same thing *without any science at all*? It is quite fatal to their cause for infidels to admit that they want more *science* to enable them to raise the dead; the apparatus of science is wholly forbidden: the feat must be achieved by *word of mouth*. If not, though scientifically accomplished, it might as well be left alone, in so far as it can, in the smallest degree, deprive the gospel miracle of its character as such. The only formula that Christ employed was —'LAZARUS, COME FORTH;' and it sufficed. The formulæ of science are very different things.

In dealing with writers who are determined to resist all but demonstrative evidence for the truth and reality of the gospel miracles, one is obliged to argue in this way. No sooner is one hypothesis disposed of than, as if in anticipation of its fate, they propound another, and then another, and so on. First, miracles are impossible, implying that they are pure lying inventions and fabrications; then, though having so much the semblance of something real as to be believed by honest and trustworthy eye-witnesses, yet, after all, they are mere delusions; then, though sensible realities, they are only feats of scientific skill, the mysterious character of which science, at some time or other, will be able to see through, and to explain on natural principles.

There is one passage in Professor Powell's Essay with which, in the sense in which we read it, we quite agree: 'In nature and from nature, by science and by reason, we neither have nor can possibly have any evidence of a *Deity working miracles*.'* Just so. The evidence is not that of science nor that of reason, and the phenomenon presented is not that of nature: the evidence of a special supernatural manifestation is simply *the evidence of the senses*, as in any *natural* phenomenon. Science and reason can be called into requisition, not for the purpose of confirming the sensible fact, but only for the purpose of explanation. The author remarks, 'Testimony, after all, is but a second-hand assurance; it is but a blind guide; testimony can avail nothing against reason. The essential question of miracles stands quite apart from any consideration of *testimony*. The question would remain the same, if we had the evidence of our own senses to an alleged miracle, that is, to an extraordinary or inexplicable fact. It is not the *mere fact*, but the *cause* or *explanation* of it which is the point at issue.' But we contend *it is 'the mere fact*,' and nothing more. To talk about the *explanation* of a *miracle* is nonsense; it is a contradiction in terms: an *explained* miracle is no miracle at all. The man who would deny the existence of a miracle,

* *Essays and Reviews*, p. 141.

because it cannot be explained, would deny the existence of what is invisible, because it cannot be seen.

The sentence just quoted furnishes another example of that extravagant latitude of statement so common with the writer of the Essay. 'Testimony is but a blind guide'! Is this true? Is it not the only guide we have, not only in tracing the events of past history — the lives and achievements of heroes and philosophers — but in many of the every-day transactions of social existence? And in submitting ourselves to this guidance, does experience prove that we are led blindly, and therefore, in general, led astray? But so firmly is Mr. Powell convinced of the 'inconceivableness of imagined interruptions of natural order,' that, as the above sentence declares, he would not believe even the evidence of his own senses to the fact, and insists that other people ought to be equally incredulous. This, however, strange as it sounds, is quite in keeping with the writer's original dogma or maxim that any interruption of natural order is absolutely impossible. The idea that there exists an *omnipotent* power is pure fiction. Some power superior to man must, we presume, have brought the material universe into existence, and have originated the 'natural order' it exhibits; but that power, whatever it be, *could not* have ar-

ranged things otherwise, else it could modify the arrangement now, which, however, is impossible. 'The Divine Omnipotence is entirely an inference *from the language of the Bible*, adopted *on the assumption* of a belief in revelation. That "with God nothing is impossible," is the very declaration of scripture; yet on this the whole belief in miracles is built, and thus, with the many, that belief is wholly the *result*, not the *antecedent*, of faith' (p. 113). [The italics are the Essayist's.]

It seems to us that such statements as these ought to preclude the Essay on the *Study of the Evidences of Christianity* from having any effect, 'dangerous' or otherwise, upon the mind of any sane and thinking person, be he Christian or not. Let it be remembered that nothing whatever in the Essay is *proved*, or even attempted to be proved: all is dogmatical assertion, which, like that just quoted, is in most cases directly opposed to what each person knows for himself to be experienced fact. Can any one who looks abroad upon creation — upon the heavens above and the earth beneath — truthfully say that, as far, at least, as his own convictions are affected by the survey, 'The Divine Omnipotence is *entirely an inference*,' not from His works, but 'from the language of the Bible'? Is it *true*, as Mr. Powell affirms it to be, that 'The philosopher denies the credibility of alleged events professedly in their

nature *at variance with all physical analogy*'? Did Locke, and Boyle, and Newton deny the resurrection of Jesus Christ? Do Herschel, and Brewster, and Babbage, and Robinson, and Lloyd deny it? A contemporary of Professor Powell, a fellow-labourer in the same field of physical research, and one who ranks considerably higher on the roll of scientific names, says: 'No doubt, in the sciences which we call physical, the only method that we can employ with success consists in observing facts, and in afterwards submitting the observations to calculation. But it would be a serious mistake to think that we can find certainty only in geometrical demonstrations, or in the testimony of the senses . . . . there exist truths other than the truths of algebra, realities other than sensible objects.'*

But in opposition to these views, which, after all, are only the views of common sense, Professor Powell (at least in his Essay) is determined to know absolutely nothing out of the domain of the mathematical and physical sciences. He un-

* 'Sans doute, dans les sciences qu'on nomme naturelles, la seule méthode qu'on puisse employer avec succès consiste à observer les faits et à soumettre ensuite les observations au calcul. Mais ce serait une erreur grave de penser qu'on ne trouve la certitude que dans les démonstrations géométriques, ou dans le témoignage des sens. . . Soyons donc persuadés qu'il existe des vérités autres que les vérités de l'algèbre, des réalités autres que les objets sensibles.'—Cauchy, *Cours d'Analyse*, p. v.

warrantably brings under their category subjects wholly without their range, and approaches those subjects in precisely the same attitude of mind with which he would sit down to examine a doctrine delivered by Lagrange or Laplace. That 'with God nothing is impossible,' is a proposition he cannot admit, inasmuch as it is not established by mathematical demonstration. He can conceive things which he himself knows to be possible, which, nevertheless, God has not actually done. On what scientific ground, therefore, ought he to admit that He *could* do them? Hume says we have no *proof* that God could make a single blade of grass more than at present exists, and mathematical or physical proof that He could we certainly have not. Why, then, should Professor Powell admit the *omnipotence* of God? It is an idea that he cannot for a moment entertain; the proof of it falls short of strict mathematical demonstration; and, from the very nature of the case, must of necessity fall short of it, even if Omnipotence actually *did* exist. However vast and magnificent the display of power, yet only a finite amount of it could be presented to our senses, or be cognizant to our minds. Why, then, should he be called upon to admit that *more* than that finite amount of power actually exists? Is it not clear that by so doing he would be assenting to an undemonstrated proposition?—

would this be philosophical? Do not the exact sciences condemn such gratuitous assent to propositions unproved, or to asserted matters of fact unverified? It is true, he does himself build upon a certain physical *axiom*, namely, that 'the laws of matter' are unalterable—that as they are now, so, without any interruption or suspension, they have always been; but this is allowable—all science has its fundamental, undemonstrable, *self-evident* truths, even geometry. 'Grant me *that*,' he seems to say, 'and what becomes of your asserted miracles, of your assumption of an Omnipotent Creator? Is it not absurd to introduce Omnipotence when there is nothing to be done? How can *any* power alter what is unalterable?'

The above is a perfectly fair summary of Mr. Powell's doctrine. It is just such a syllabus of the Essay as an industrious student would prepare if he had to pass an examination upon it by the Oxford professor. If it should be read by any person who has not perused the Essay itself, that perusal, except for the graces of composition it exhibits, will be quite unnecessary. And we are willing to admit that if the condensed sketch of what is here stated to be the philosophical and theological views of Professor Powell, as unfolded in his work, be in any respect overcharged or unfairly coloured, we must have erred wilfully. He has delivered his opinions with clearness and pre-

cision; and no careful reader of them can mistake what those opinions are, what they assume, what they reject, and what they inculcate.

And now, in closing these remarks, the author of them cannot but express his deep sorrow that he should have had any occasion to speak of one whose scientific attainments he had always admired, whose moral character he had always respected, and whom he had been privileged to call his friend, in the way he has been here constrained to speak of Professor Powell. Most of his publications are valuable gifts to science: this, *his last*, is a legacy to — what? It exhibits a phenomenon which, fortunately, is not often witnessed, a species of intellectual suicide. Is it not possible that, so shortly before his departure from this life, his mind, long and laboriously strained by the deep and difficult investigations in which he was continuously engaged, may have become unhinged, his intellectual vision obscured, and that he was unconscious to himself, in this, his final contemplation of the *Evidences of Christianity*, that he was 'seeing through a glass darkly'?

There can be but little doubt that the tendency of Professor Powell's Essay, as well as that of some of his immediately preceding controversial writings, is decidedly atheistic. But the *tendency* of a writing may be very wide of the *intention* of the writer; and the present author does not believe

that the Rev. Baden Powell would designedly advocate atheistic doctrines, much less that, in his heart, he cherished them himself. He fully recognises the 'living Divine instruction' which the Apostles and their contemporaries enjoyed (*Essays and Reviews*, p. 143), and he speaks of the constancy of nature as forming 'the substantial basis for the grand conclusions of natural theology' (p. 110).

In the foregoing comment upon his Essay, we have had to do solely with the *tendency* of the performance; and can account for the fact, that a man of Professor Powell's clearness of intellectual vision, in matters of pure and applied science, should have been so beclouded on other subjects, only on the hypothesis that his mind was thrown into an abnormal condition whenever, of late years, he addressed himself to that particular class of inquiries which forms the subject of his Essay. Instances have before occurred where intellects, as strong and clear as his, on all topics but *one*, have exhibited, in reference to that one, a singularity of view and perverseness of judgment quite as remarkable. (See No. 88 of Dr. Hawkesworth's *Adventurer*.)

NOTE: ON HUME'S ESSAY ON MIRACLES.

The Position of Hume, in his Essay on Miracles, amounts to this, namely: — That no amount of human testimony *for*, can counterbalance the weight attached to the uniform experience of mankind *against* a departure from the course of nature. This position, as it does not go the length of openly assuming a departure from the course of nature to be impossible, can be grappled with and examined upon mathematical principles. It has been so examined, and the two following propositions have been rigorously demonstrated :—

1. If thirteen impostors, or thirteen insane or deluded persons affirm, without collusion, that they were eye-witnesses of a miracle — supposing even that only *ten* pretended miracles could be invented or suggested to their minds, the probability that they affirm the truth is *five times* as great as the probability for the constancy of the laws of nature.

2. If thirteen witnesses, whose veracity is such that they each tell *one* falsehood in every *ten* statements they utter, testify, without collusion, to the occurrence of a *specified* miracle, the probability of the truth of their statement is, as before, *five times* the probability for the constancy of nature.

The additional datum for the calculation of

the probability in each of these cases is this: Assuming with Laplace that the origin of the human race was about 6,000 years ago,* and that thirty years is the average duration of a generation, 200 generations must have passed away; and allowing the average population of the earth to have been a thousand millions, we find that there have lived and died since Adam, about two hundred thousand millions of individuals: the experience of all these in favour of the *non-occurrence* of a miracle is therefore *two hundred thousand millions to one.* Calculation with this datum shows incontrovertibly, that if only thirteen individuals under the above conditions testify to the *occurrence* of a miracle, the probability that the miracle *did* occur is a *million millions to one.* [See the mathematical proof in the Note at the end.]

It is the drift of Hume's argument to establish the position, that the occurrence of a miraculous event ought to be believed only by those who were the actual eye-witnesses of it. Now, admitting it to be necessary, although certainly not sufficient, that the bearer of a divine message should authenticate his mission by the working of a miracle, it would follow, in order that all might receive this message, that all should be eye-witnesses of the

* This assumption—which disregards the Deluge—is the most favourable possible for Hume's position.

miracle; and, moreover, as traditional evidence and the experience of others, whether verbal or recorded, goes for nothing, it is further necessary that the miracle be repeated to each succeeding generation, and so on to the end of time. But a phenomenon that thus presents itself to the observation of mankind age after age with unfailing certainty is not *a miracle*, but *a law of nature*; if not, what is it that distinguishes the *law* from the *violation*?

The partisans of Hume might escape this dilemma by proposing that the *same miracle* should not be repeated age after age, but that there should be a succession of *different* miracles, or of violations of law in different departments of nature. But these so-called violations of law would be destructive of all law, for no department of nature being uniform in its phenomena, no laws could be recognised, and consequently no miracle.

It is therefore absolutely essential, in order that miracles may retain their character as such, and produce their intended effect upon our belief, that they be of infrequent occurrence, and be handed down from age to age, as the recorded testimony of eye-witnesses. And it is strictly true that the force of human testimony, in a matter of this kind, comes at length to exceed that of actual personal experience, since, as just shown, miracles

which every successive generation is called upon to witness either at length fall in with the laws of nature, and thus lose their character and effect, or else they render those laws so obscure and ambiguous, as to leave the breach of them undistinguishable from their performance.*

In fact, Hume's argument involves this palpable contradiction in terms, namely, that Omnipotence *cannot* work a miracle that shall be admitted by mankind to be such; for what is possible may be assumed to be actual, at least as an hypothesis which reason and common sense can admit. But in as far as Hume's argument shows the position of the *reality* to be untenable, in so far does it show the *hypothesis* to be untenable. His reasoning remains just the same, whether the premises are real or hypothetical. Indeed, a logical and abstract argument on *any* subject must remain the same, whether the premises or hypothetical conditions be true or false. Hence, as stated at p. 145, Hume's conclusion is substantially the same as Powell's original assumption: the reasonings which show that a miracle never *did* take place equally show that a miracle never *could* take place. In other words, that a Being is omnipotent and not omnipotent at the same time. To an atheist such reasonings, though sufficiently con-

* The above remarks are from the author's *Three Lectures on Mathematical Study*, 1846. Longman & Co.

clusive, would be absurdly supererogatory: *he* necessarily denies the possibility of a miracle, because he denies the existence of the Power to work one. But whoever admits the Power, cannot successfully contend that it was never exerted, even if no such manifestation was ever recorded, unless indeed that Power had itself clearly revealed the fact, that it had never specially declared itself to man in that way.

SECTION V.

ON THE MIRACLE OF JOSHUA, AND THE VIEWS OF BISHOP COLENSO: — ON THE SUPERNATURALLY IMPOSSIBLE, AND THE DOCTRINE OF TRANSUBSTANTIATION.

THE so-called discrepancies between Science and Revelation are alleged to be more especially apparent with regard to the scripture miracles, a subject with which in reality science has nothing at all to do. The domain of physical science, as its name implies, is confessedly limited within the boundaries of what is called material nature, and any transgression of those boundaries, by incursions into the regions of the supernatural, is a violation of the very conditions under which physical science exists. In the domain of the supernatural it must ever be powerless.

This is a position that no one disputes. 'All reason and science,' says Professor Powell, 'conspire to the confession that, beyond the domain of physical causation, and the possible conceptions of intellectual knowledge, there lies open the

boundless region of spiritual things, which is the sole dominion of faith. And while intellect and philosophy are compelled to disown the recognition of anything in the world of matter at variance with the first principles of the laws of matter, the universal order and indissoluble unity of physical causes, they are the more ready to admit the higher claims of Divine mysteries in the invisible and spiritual world. Advancing knowledge, while it asserts the dominion of science in physical things, confirms that of faith in spiritual. We thus neither impugn the generalisations of philosophy nor allow them to invade the dominion of faith, and admit that what is not a subject for a problem may hold its place in a creed.' (*Essays and Reviews*, p. 127.)

Now, disregarding the obvious animus of this passage, and the seemingly ironical tone in which it concludes, we remark that a miracle which has to do with physical things is anything but a matter of faith; it is a matter of sense and observation, as much so as any natural phenomenon; and the only reason why it cannot be explained in the same way — why natural science is inadequate to investigate its cause, is, that it is *not* a natural phenomenon, but a *miracle*; to *prove* the reality of a miraculous occurrence, by a reference to physical laws, would clearly be to *disprove* it. Investigation can establish its miraculous character

only by showing the occurrence to be inexplicable by physical science — to be altogether beyond its reach, and external to its laws.*

To speak, therefore, about either discrepancy or agreement between a natural and a supernatural event, is to use words without meaning; it is to speak of comparing together things essentially heterogeneous, and therefore incapable of comparison; it is as if we were to talk about agreement or disagreement between the laws of thought and the laws of gravity. And the remarkable fact, that there are people who do not see the absurdity of instituting any such comparison, can be accounted for only on the supposition of either dogged perversity and wilful blindness, or of intellectual infirmity on a particular subject.

But although physical science can never enable us to explain a miracle, that is, to discover *how* it is performed, it may nevertheless sometimes aid us in discovering *what* is performed; it may enlighten us as to the thing actually done, though it can never instruct us as to the way of doing it. In contemplating any one of the scripture miracles, the question, What were the supernatural operations? may be reasonably and profitably entertained; the question, How were they executed? it would be presumptuous folly to put.

* 'Nothing better characterises a miracle than the impossibility of explaining the effect of it by natural causes.'—*Buffon.*

In reference to the permissible question, What was done? there is perhaps no miracle in scripture more fit to be included among the 'things hard to be understood' than the miracle of the sun's standing still, as recorded in the book of Joshua.

'SUN, STAND THOU STILL UPON GIBEON; AND THOU, MOON, IN THE VALLEY OF AJALON' (Joshua x. 12.)

It is here proposed to submit a few reflections on this most remarkable and interesting event.

But, first, we would invite attention to the recorded fact, that Joshua's command that the daylight might be prolonged, was, so to speak, by pre-arrangement on the part of the Almighty with him, since, before his sublime apostrophe to the sun and moon, 'Joshua spake to the Lord.' It had been given to the mighty warrior to foresee that, unless the day were lengthened, a miracle of some other kind would be necessary, in order that the enemies of God might be exterminated before the approach of night. And although 'he said in the sight of Israel, Sun, stand thou still upon Gibeon; and thou, moon, in the valley of Ajalon,' yet the spirit and intention of the appeal unquestionably were—Let not daylight wane. As before noticed, this request or demand Joshua had been previously authorised to make, though assuredly not to dictate the manner in which it should be

granted. So that the day was sufficiently prolonged, it could not have been of the slightest moment to Joshua whether this object, the accomplishment of his only wish, were effected in the way he prescribed or in any other way. It *might* have been effected, without any violation or suspension of the laws of nature, in the manner now to be described.

It has already been stated to be a scientific position, generally admitted by modern investigators of the phenomena of light, that light is not an emanation of luminous particles from a luminous body (as was formerly supposed), any more than sound is an emanation of sonorous particles from a sounding body. In each case a medium of conveyance is found to be necessary. The vehicle of light is the luminiferous ether; the vehicle of sound is the common air of the atmosphere. It is necessary, too, in order that the luminous body should be seen, and in order that the sounding body should be heard, that the conveying medium should be *continuous* between the body and the eye, in the one case, and between the body and the ear in the other case.

If there be any interruption of this continuity, any interposed void between the eye or the ear and the body itself, that body becomes invisible in the one case and inaudible in the other.*

* To prevent all misconception here, it is as well to state that

Suppose, now, that such a void or vacant gap were introduced immediately above the scene of Joshua's operations, by the retiring or collapsing of the upper regions of ether, the lower regions remaining in their previous condition, but cut off from all union with the upper by the interposed vacuum. The consequence would have been that the heavenly bodies would have ceased to be visible throughout the locality thus isolated; and yet if the vibrations essential to light of the lower stratum of ether were not suffered to cease, but were maintained in their previous activity, the sun and moon would not have been missed, and light, without any abatement of intensity, would have continued to be supplied.

And we may fairly presume that, as Joshua and his host were hourly experiencing the substantial efficacy of the appeal to the sun and moon, they were too much occupied in turning the miraculous prolongation of the day to account,

we merely affirm that neither undulations of the ether, nor of the air, could directly cross this vacuum. Whatever impressions reached the eye or the ear would come indirectly, and would divert the organ *from* the real exciting cause of those impressions; and the more extensive the vacuum, the feebler would the impressions be. In the case of light, the luminous body would be wholly invisible.

It is scarcely necessary to advert to the well-known fact, that from a bell, suspended in the exhausted receiver of an air-pump, no sound can be emitted; the continuity of the medium for conveying sonorous vibrations being interrupted.

by a vigorous prosecution of the battle, to scrutinise whether the advantage sought, and so adequately realised, was conveyed through the instrumentality of those luminaries or not. It was impossible indeed that they could have satisfied themselves by any such scrutiny, since, notwithstanding the effulgence of day with which they were surrounded, the sun and moon would not have been visible.

This state of things continued, it seems, 'about a whole day'—that is, *about* the time occupied by one rotation of the earth — at the expiration of which time, the ether resuming its normal condition, and the duration of the miracle ending, the sun and moon would reappear, the former still 'upon Gibeon,' and the latter, though not so close to the same spot, would still have remained 'in the valley of Ajalon.' And all the phenomena would, to the eyes of the people, have been just the same as if the sun and moon had stood still, or the apparent motions of the two luminaries been actually arrested, as the witnesses of the phenomena were allowed to suppose.

The temporary separation of the upper and lower portions of the ethereal fluid, conceived above to have taken place, whereby the previous continuity was for a time interrupted, is analogous to the temporary separation of the aqueous fluid in the passage of the Israelites through the Red

Sea. As in this latter case it would have been physically impossible for a floating body to have passed from right to left, or from left to right, across this passage, so would it also have been physically impossible for light to have passed through the vacant passage hypothetically assumed above, how narrow soever that vacuum may be supposed to have been. So strictly analogous are these two miracles, that there is precisely the same kind of physical difficulties in the way of the accomplishment of the one, as in the way of the accomplishment of the other. But to those who entertain worthy and becoming notions of Deity, physical difficulties can never be regarded as insuperable obstacles to which even Omnipotence must yield. Men of peculiarly constituted minds may perhaps consider that they *are* such insuperable obstacles, and may be disposed to regard the one miracle and the other as alike impossible. But in reference to *any* miracle, this is only the expression of mere individual opinion, in support of which they never have been able to offer anything like satisfactory reasoning. Still, the miracle in question has been often selected, and more especially of late, as that which necessarily involves a greater infraction or violation of the laws of nature than any other.

In a recent celebrated trial in the Court of Arches, it was publicly declared by the advocate

for the defendant, that the miracle here commented upon had been proved by physical science to be impossible, as if physical or *natural* science could have anything to say either for or against any phenomenon avowedly SUPER-natural. The hasty and ill-advised assertion appeared, no doubt, to be justifiable on the ground that the miracle implied a violation of the laws of nature so great as, for the time being, to upset nature altogether; but, as here shown, there *need* not have been any violation of the laws of nature at all.

The above attempt to describe (not to *explain*) what supernatural acts were adequate to produce the phenomena in question, is not an attempt to which we are *driven*, in consequence of the supposed insuperable *physical* difficulties in the way of accounting for what took place, on the principle that the motions of the earth and moon were actually arrested; but it is suggested solely from the pretty generally admitted fact, that in all the operations of Deity consummate wisdom is as conspicuous as unlimited power; and, therefore, that omnipotent though He be, no more power is ever expended by the Deity than is sufficient for the accomplishment of the predetermined result.* It is absurd to talk of physical

* No more convincing proof of this can be even conceived than that furnished by the planetary motions, the laws of which are such that although it is the physical *duty*, as it were, of each to

difficulties standing in the way of a miracle. That which physical science can show to be possible, upon its own principles, must be deficient in the very essential of a miracle, which implies the performance of something which nature alone

disturb and derange the movements of all the others, yet the perfect stability of the whole of the celestial machinery is of physical necessity secure. In reference to the complicated and embarrassing contrivances, which Ptolemy considered to be necessary to produce these motions, King Alphonsus of Castile — himself well versed in mathematics — declared, with more apparent than real irreverence, that if he had been the Almighty's counsellor when He planned the universe, he would have advised Him better. But much more recently great astronomers have imagined that, with the same expenditure of power, greater advantages might have been secured; but it has been afterwards found that all their fancied improvements would have been so many injurious defects. Laplace, for instance, affirmed that the arrangement might have been such, with respect to the earth and moon, that the latter might have constantly ruled the night as the sun does the day; subsequent physical astronomers have investigated the consequence of his proposed improvement, and have shown that instability of the system would have been the necessary consequence, while the anticipated advantages would have failed to follow after all.

'M. Liouville, a démontré (Additions à la Connaissance des Temps pour 1845) que dans cette solution le système formé par les trois corps est instable; en sorte que, dès qu'il est légèrement troublé, il tend à se déranger de plus en plus d'une manière rapide. Il en résulte que si ce système avait été réalisé par le Créateur dans le soleil, la terre, et la lune, la lumière de la lune, loin de remplacer constamment celle du soleil pendant les nuits, comme l'affirme Laplace dans l'*Exposition du Système du Monde*, aurait été probablement moins fréquente qu'elle ne l'est dans l'état actuel des choses.'—Jullien, *Problèmes de Mécanique Rationnelle*, tom. ii. p. 29. 1855.

cannot possibly perform. A storm may naturally subside into a calm; but *nature* cannot instantaneously stay the tempest by the mere utterance of 'Peace, be still.' In the case before us the Deity could, no doubt, as readily suspend the motions of the earth and moon as He could originate those motions. If not, why not? It would be idle, in the way of objection to His so doing, to descant upon the catastrophe that upon natural or physical principles would otherwise follow.* The question simply is, Did He do this, merely to produce a local and temporary effect, or did He accomplish the object by simpler means? Archdeacon Pratt, in his *Scripture and Science not at Variance*, remarks, that 'the accomplishment is supposed by some to have been by the arresting of the earth in its rotation;' in reference to which, Bishop Colenso, in his *Pentateuch and Book of Joshua critically examined*, says, 'It will be observed, that Archdeacon Pratt does not commit *himself* to maintaining the above view: he says, "it is supposed *by some*" to have been accomplished thus. But he argues as if this explanation were possible, and not improbable; that is to say, he lends the weight of his high position and mathematical celebrity to the

* This remark was written, and *in print*, long before the publication of Bishop Colenso's work, quoted in this page in reference to the miracle of Joshua.

support of a view which every natural philosopher will know to be wholly untenable. For, not to speak of the fact, that if the earth's motion were suddenly stopped, a man's *feet* would be arrested, while his *body* was moving at the rate (on the equator) of 1,000 miles an hour (or, rather 1,000 miles a *minute*, since not only must the earth's diurnal rotation on its axis be stopped, but its annual motion also through space), so that every human being and animal would be dashed to pieces in a moment, and a mighty deluge overwhelm the earth, unless all this were prevented by a profusion of miraculous interferences, one point is at once fatal to the above solution.* Archdeacon Pratt quotes only the words, "So the *sun* stood still in the midst of heaven, and hasted not to go down about a whole day;" and although

* We do not at all understand what the author means by 'one point,' &c.

Should Archdeacon Pratt ever see Bishop Colenso's work on the Pentateuch—which title, by-the-bye, is a misnomer, since the early portions of the most important of the five books (Genesis) are passed over in silence—he will find, on turning to the passage quoted above, that not only does the bishop differ from him in matters of scripture, but also on points of science. But it does not require the scientific sagacity of the distinguished author of the 'Mechanical Philosophy' to detect Bishop Colenso's mistake: —'If the earth's motion were suddenly stopped, a man's *feet* would be arrested, while his *body* was moving at the rate of 1,000 miles a minute.' Every tyro in Dynamics will see that the feet would advance miles, before the body could even reach the ground.

this is surely one of the most prominent questions in respect to which it is asserted, that "scripture and science are at variance," he dismisses the whole subject in a short note, and never even mentions the *moon*. But the Bible says, "the sun stood still, and the moon stayed" (Josh. x. 13), and the arresting the earth's motion, while it might cause the appearance of the sun "standing still," would not account for the moon "staying."' And the bishop then adds, 'It is impossible not to feel the force of Archdeacon Pratt's own observation (p. 30), "The lesson we learn from this example is this: How possible it is that, even while we are contending for truth, our minds may be enslaved to error by long-cherished prepossessions!"'

We should not occupy our space by quoting such puerilities as these but for the purpose of confirming, by a newly-furnished example of the fact, the opinion expressed at p. 166 in reference to the peculiar distortion of mind of certain anti-Bible writers, who are now cropping up into notice in pretty rapid succession.* It is difficult

* The author is not singular in the opinion that the perverted views of the writers here referred to are fairly attributable to a mental obliquity in reference to particular subjects. A recent writer, who has diligently searched both scripture and science, remarks, 'A school of negative criticism, which translates Psalm xxii. 16—"For lions have compassed me, the assembly of the wicked have inclosed me, as a lion my hands and my feet," and then makes these hands and feet to be those of the whole Jewish nation, is more akin to lunacy than to real learning. A

to conceive how any man in his sober senses could write and publish to the world such circumstantial nonsense as the above. It seems that Archdeacon Pratt, in his brief note on the miracle of Joshua, 'lends the weight of his high position and mathematical celebrity to support the view,' that Omnipotence could stop the motion of the earth; and his episcopal critic turns round upon him, and triumphantly asks—But how about the *moon*? In another edition of his book Archdeacon Pratt had better distinctly say, for Bishop Colenso's individual satisfaction, that God can stop the motion of *that also*.

But what does Bishop Colenso mean by the assertion, that 'every natural philosopher knows the view to be wholly untenable?' Natural philosophers in general know just the reverse: it is this *assertion* that is untenable, not 'the view.' But we again ask, what has natural philosophy at all to do with a miracle? A mere child would know that, by whatever philosophy supernatural phenomena were to be investigated, it could not, at any rate, be *natural* philosophy.

In the foregoing quotation the bishop details

vast induction, composed of such elements, may prove to be only an accumulation of learned folly. A pathway of prophetic interpretation streaming with such light, merely illustrates the words of our Lord—"If, then, the light which is in thee be darkness, how great is that darkness."'—*The Bible and Modern Thought*, by the Rev. T. R. Birks, M.A.

some of the dreadful consequences that would inevitably ensue 'if the earth's motion were suddenly stopped.' The battle would have terminated in a very summary and awful manner, for both armies, Joshua among them, would have been instantly swept into destruction. We would venture to suggest, however, that the Being who could stop the motion of the earth might possibly be able *also* to stop the motion of the things upon it; and this hint, too, we would respectfully submit to Archdeacon Pratt's consideration in a future edition of his book. But Bishop Colenso himself appears to suspect that the disasters he has depicted might be 'prevented by a profusion of miraculous interferences.' Seeing the bishop's proneness for Rule-of-Three calculations, as shown throughout his book, we should not have been much surprised if he had proceeded to compute the actual number of these 'miraculous interferences.' The miracle of quelling the storm, briefly alluded to above, might furnish something in the form of data. There was one 'miraculous interference' to allay the raging of the wind; another to quiet the turbulence of the waters; and a moderate fraction of a miracle — say one-fourth, to prevent the subsequent ground-swell. The number would come out pretty large, even supposing that one 'miraculous interference' could suffice for a batch of so many as ten persons.

The interferences, however, be it remembered, need only extend to the '*body*:' the '*feet*,' it seems, could take care of themselves. 'How possible is it that, even while we are contending for truth, our minds may be enslaved to error by long-cherished prepossessions!'

We ought perhaps to apologise for the above tone; but really there are some absurdities so ridiculous, that seriousness in the discussion of them is scarcely to be expected.

And a ridiculous absurdity it is, to pit the laws of intellectless material nature against the irresistible WILL and Wisdom of Omnipotence; and, in spite of the every-day personal experience of every human being, to deny that mind can act upon matter. Every man moves his limbs, within certain limits, *at will*. Can any physical science explain *how* the mere volition instantly generates the motion? If the Will of God can originate, or control, or stop the movements of the matter He has created, only just as the will of man can originate, or control, or stop the movements of the matter he carries about with him — if He *can* do this, on what justifiable grounds is the *possibility* of His arresting even the earth to be denied? Yet denied it is: God is not to control matter, but matter is to control God!

The calamitous consequences which Bishop Colenso deduces from the event in question

follow—and, on the whole, fairly follow—from an hypothesis of his own. The hypothesis of the *Scripture* is a totally different one. *He* assumes the earth to have stopped *of its own accord*, the apparent motions of the sun and moon to have ceased of themselves, the chronometer of heaven to have run down, and hence his catastrophes. The earth did not *stop*; it was *stopped*, supernaturally stopped. Physical causes lead, of course, to physical consequences; and, just as much of course, ordinary physical consequences imply physical causes; but in the case before us, physical causes and consequences are wholly out of the question, as every one with undistorted mental vision must see.

Writers of the class to which Bishop Colenso has chosen to unite himself would become much more intelligible if they would only state explicitly, at the outset, their own convictions of the Deity, instead of leaving their readers to infer them from amidst the puzzles and contradictions thrown in their way. As it is, the only consistent inference is, that, in their view, the Deity is entirely excluded, by impassible barriers, from all intermeddling with nature; that, whatever be His power, He is peremptorily interdicted from every special manifestation of that power within the boundaries of the material world. If they do not labour under a species of monomania, this must

be their theism; and if so, they are consistent in rejecting 'miraculous interferences,' and in firmly maintaining the inviolability of physical laws.

The *Bible* declares that man was made in the image of God. The most unmistakeable feature in that image is man's intelligent *will*, as displayed in his power to coerce matter, in his power to lay his hand upon it, to disturb its natural repose, to convert its rest into motion, and to mould and fashion it as he *wills*, though he is constituted to do all this only within certain limits. Yet one would think that a contemplation merely of the wonders which the *human will* has called up around us, would suffice to make us careful not to too much limit the power of the *Divine will*, even if God were made in the image of man; that is, even if we could conceive of the Supreme Being as no more than a vastly exalted type of the human.

From these considerations we feel not the slightest difficulty or hesitation in admitting the possibility of Almighty Power arresting the motion of the earth, if it be His will to do so; and as to consequent catastrophes, it is absurd to advert to them. In his enumeration of these, Bishop Colenso has omitted one, and an important one, namely, that one-half of the globe, 'for about a whole day,' would have been kept in total darkness, even if the calamitous results he has

mentioned had been provided against. But we have seen (p. 87) that light is not an emission of luminous particles from the luminous body, but that it is a distinct thing—that it is not matter at all, but motion. If this were communicated, the sun would not have been missed from the opposite hemisphere.* There are many days now—this present 5th of November, 1862, for instance—in which, from morning till night, the sun is wholly invisible in the neighbourhood of London, giving not the slightest ocular proof of its actual presence in the sky. Still we think it unlikely that the phenomena in question were brought about by thus arresting the course of nature, or, if the expression be preferred, by violating any of nature's laws; because we conceive that no more than what was absolutely necessary was actually done; and we have ventured above to describe what *might* have been done to accomplish the end designed, without any violation of the laws of nature. An objector may, if he please, say that the withdrawal of a portion of the ether from the entire mass, so as to cut off continuity, and produce a temporary vacuum of limited extent over Joshua's locality, was such a violation; but, on like grounds, he

* We are not here increasing the 'profusion of miraculous interferences;' we require but *one* miraculous interference throughout—but one fiat of Omnipotence—to produce all the phenomena in question.

might say, that the withdrawal of the air from the receiver of an air-pump is a violation of law. If the receiver-full of air were to be abstracted without physical means, and the surrounding air kept from infringing upon the vacuum, independently of material barriers, the two cases would be strictly analogous. If in either case it be said that there would be a violation of a natural law, we ask, of what law? We submit that no previously existing law of nature would be violated at all, but that antagonistic energy, external to nature, in the case of the miracle, and paramount to its laws, would be in operation; those laws themselves, so far from being suspended or destroyed, striving for the mastery all the time, and manifesting their unimpaired efficiency the instant that the new power was withdrawn.*

* In a miracle, such as that considered above, the withdrawal of the supernatural power *from* nature is as necessary to establish the miraculous character of the recorded event as the putting forth of that power *into* nature is: since such power permanently acting would come to be regarded as a *natural* power. Professor Powell, in distinguishing between what he calls such *physical* miracles and *moral* miracles, says: 'Those who have felt the greatest difficulty in admitting *physical* miracles, have no hesitation in accepting the assertion of any amount of *purely moral and spiritual* influence . . . and theistic reasoners have held it more consonant with Divine perfections to influence mind than to disarrange matter.' (*Order of Nature*, p. 282.) But what is the principal object of this so-called disarrangement of matter *but* to influence mind? The '*physical* miracles' of the Saviour

An objection may certainly be made to the foregoing conjecture as to what the miracle in question actually was, or might have been, in consequence of it being said, 'And the sun *stood still*, and the moon *stayed*, until the people had avenged themselves upon their enemies'—a statement which can be reconciled with the above view of the phenomena only on a principle, pretty generally found to prevail in scripture, namely, the speaking of the sensible appearances as realities, just as the appearance of the sun rising or setting is spoken of as a reality. The sun *appeared* to have stood still, just as it *appears* to rise and set, and to have delayed going down for about a whole day, and the effects actually witnessed were precisely the same as would have taken place had the apparent been the real phenomena. And upon this principle collision with science is avoided, whether the reader of the narrative be a Ptolemaist or a Newtonian, the conception of the *appearance* being the same to both. (See the remarks at p. 26.)

Nevertheless, if dissatisfied with the record of mere appearances, we resolve to search for their real proximate cause, physical science may occasionally help us in that search, and enable us to

always had this object, over and above that of material benefit to those on whom they were wrought: 'Believe me for the very works' sake.'

gain a clearer notion of what certain supernatural operations (so to call them) really were; or as to what miraculous acts the appearances were, or at least might have been due. But to set about explaining *how* these were performed, or, finding them to be inexplicable, to pronounce them to be impossible, would be to practically deny that they were supernatural acts at all; it would be to make the Creator of nature to be Himself a part of nature, a portion of His own creation; since phenomena that natural or physical science can explain are only those which Nature of herself presents. Beyond and apart from these, physical science cannot *explain* anything whatever. Phenomena *supernaturally impossible*, are exclusively such as those instanced in the following article: —

'WITH GOD NOTHING SHALL BE IMPOSSIBLE' (Luke i. 37).

This declaration simply enunciates the fact that God is omnipotent. But we do not set any limits to His power, or speak irreverently, when we say that His acts can never be such as to conflict with, or oppose, or contradict one another. They can never be such as to place the Deity in a dilemma. Omnipotence cannot command two contemporaneous events, if the essential condition of their occurrence be, that the existence of either *necessarily* forbids the existence of the

other *at the same time.* Such a conjunction or concurrence of contradictory events would not be a *miracle.* It would be utterly beyond the scope of even miraculous power, and would be as much a supernatural as a physical impossibility. For instance, Omnipotence cannot cause a body to be, or even to *appear* to be, black and white at one and the same instant to the same individual; for the appearance of black *necessarily* excludes the appearance of white, and the appearance of white as necessarily excludes the appearance of black. Cases of such an impossible concurrence of contradictory phenomena may be put in *words*; but no mind can conceive them, nor any power produce them. If contradictions could be reconciled, they would cease to *be* contradictions, which is absurd.

None of the miracles of scripture are marked by any such absurdity. If they were, they would be more than incomprehensible, they would be intrinsically impossible and incredible. No human being could accept them. When Lazarus was summoned forth from the grave, and stood a living man in his Master's presence, it was not pretended that he was at the same time dead and in his tomb. The two conflicting events could not have occurred simultaneously, even by the working of a miracle; for they were *necessarily* contradictory of each other. So when Elisha

caused the solid iron to swim, the metal could not have been swimming and sinking at the same time; for the command that it should swim was, in fact, a command that it should not sink. In like manner, the rod of Moses could not have been a rigid stick, and *at the same time* an undulating serpent.

In the case of the loaves and fishes, the miracle consisted either in multiplying the number of these, or in increasing their magnitude, or in both miraculous acts; but it would have exceeded a miracle, and have been supernaturally impossible, to have preserved the loaves and fishes precisely as they were at first, and yet, after the repast, to have gathered up of the fragments remaining many-fold of the bulk of, as to quantity, the still intact materials; for then these materials would have been of a certain bulk, and of another far greater bulk, at one and the same time, which is no miracle, but a palpable absurdity.

These truisms naturally suggest reflections in reference to the alleged miracle of *transubstantiation*; and though we should never go out of our way to gratuitously offend the religious feelings or prejudices of any body of men, more especially of men to whom, in all ages, learning and science owe so much, yet, in the prosecution of our present purpose, it is incumbent upon us to point out the marked distinction between what is

supernaturally possible and what is supernaturally impossible.

In the celebration of the Eucharist by our brethren of the Church of Rome, it is maintained that there is not merely a commemoration, but a faithful imitation — in fact, a reproduction of the Last Supper of our Lord — and that, in order to this faithfulness of imitation, the Body of Christ must be actually and substantially present in the Host; and the members of that Church, in confirmation of this their view, appeal to such passages as Matt. xxvi. 26–28, wherein the institution of the ordinance is recorded.

Now we assert that, however honest and pious such an appeal may be, it is made under an erroneous impression of the meaning of the text. It was *impossible*, physically and supernaturally impossible, that the material Body of Christ could, at one and the same time, have been wholly and substantially at the table with His disciples at the Last Supper, and *also* wholly and substantially in the sacred elements. The assertion, or fact, that the material Body was at the table, *necessarily* involves the assertion, or fact, that it was not anywhere else. Erudition and speculation as to whether the words, 'this is my body,' had a literal or a figurative signification, are quite thrown away; the literal transubstantiation — the whole material Body still occupying its place

at the table—was beyond the power even of a miracle: the existence of either fact excluded, of inherent necessity, the contemporaneous existence of the other.

But even admitting the conjunction of both (*conceive* it we cannot), still the Romish celebration of the Eucharist cannot be, as it is declared to be, a complete imitation of the Lord's Supper. The body into which that Church affirms the bread to have been transmuted at that supper was the body of *the breaker of the bread.* In the imitative ceremony, the body into which the bread is converted, in order that the imitation may be complete, ought to be the body of the *priest,* not the Body of Christ, who is not otherwise substantially present. If the priest be not transubstantiated into the Body of Christ, neither can the bread be, without a most essential departure from the original—a most important omission of obedience to the command, 'Do *this.*'

But even if, in the original supper, Christ had by miracle actually transferred His material Body to the bread, and had only *appeared* to His disciples to still remain at the table, yet no miracle could have converted each separate morsel into the same *one* body. The presence of the material body in any one morsel necessarily excluded its presence from every other morsel; and the same in the Roman Catholic ceremony, even admitting

transubstantiation. In this ceremony more than transubstantiation is contended for: the same material body must be *wholly* in each separate and distinct morsel at one and the same time, which is physically and theologically impossible.

A miracle implies a supernatural *act* — something done. If the miracle be independent of any pre-existing material, it is a creation; if it be wrought upon matter, that matter must, as a result, be supernaturally changed either as to its local situation or as to its previous physical condition, or as to both. By the action upon it of a new power, its natural tendencies or phenomena may be modified or counteracted, or even destroyed, and replaced by others. The conversion of the bread at the Lord's Supper into another body involves no supernatural difficulty: a miracle could, doubtless, have been wrought upon *that*. There is nothing self-contradictory in the change of one body into another. But in the Romish view a supposed miracle was *also* wrought upon the Body of our Lord: He was transferred from the table at which He sat, to the bread, and yet was bodily in presence at that table from the beginning to the end of the repast; that is, He was transferred and not transferred at the same time — a palpable contradiction, and not a miracle. Either one of the two conditions necessarily excludes the other, and

their contemporaneous existence is impossible even with God.

But such an inherent impossibility as that here instanced cannot be comprehended among the 'all things possible with God.' He cannot act and forbear to act in one and the same instant. He cannot affirm and deny in one and the same utterance. Omnipotence cannot make the three angles of a plane triangle to amount to more or less than two right angles, simply because the existence of a triangle necessarily implies the existence of this property. To affirm that the angles of a plane figure amount to more or less than two right angles, is at the same time to affirm that the figure is not a triangle. And equally true is it that the affirmation that a specified material body is in a specified place, necessarily involves *also* the affirmation that it is *then* nowhere else. What *is* anywhere else cannot possibly be *it*, but must be another body.

There is thus a clear and broad distinction between a miracle and an impossibility. A *physical* impossibility the former *must* be, else it is not a miracle, and a physical impossibility it *may* be, without any infraction of a physical law. Something that is not Nature's own may be temporarily added, for a special purpose, without anything that *is* her own being taken away.

And we think it of some importance to have

pointed out and illustrated this distinction. Professor Powell has entirely overlooked it. Throughout his Essay, his mind has been dwelling exclusively upon the supernaturally impossible, not at all upon miracles: how else could he have adduced, in a controversy concerning *miracles*, the supernaturally impossible instance of two and two being five? There is a precisely similar barrier between the supernaturally possible and the supernaturally impossible, as there is between the physically possible and the physically impossible.

If a person were to aver that on a certain day, in our latitude, he had observed the altitude of the sun to be eighty degrees, we should pay no attention to him, and should turn a deaf ear to all his details and explanations; we should know the occurrence to be physically impossible. In like manner, if he were to declare that he had witnessed a miracle causing a thing to be itself and a different thing at one and the same instant, or to occupy two distinct places at once, we should equally disregard his testimony, knowing that the alleged event is as impossible with God, as the other is with nature.

We conclude this section with the following observations from one of our most eminent mathematicians and natural philosophers: —

'There is no cause and no effect antecedent to the *Will* of an *Intelligent Creator*. When it

pleases Him, He can give effect to His Will without the intervention of means. This is a mere exercise of *Power*. But generally He works by means, that is, according to *laws*. There is no necessity for operating in this manner beyond that which is involved in making His Wisdom known to *men*, as well as His Power, for the express purpose of creating them like Himself. Essentially, therefore, the laws are such as *we* can comprehend, it being by study and knowledge of laws that man's intellectual nature is perfected, as by acting according to Divine laws his moral nature is perfected. It is thus that we become partakers of the "Divine nature" spoken of by St. Peter (2 Pet. i. 4). The great advances that have been made in natural science in modern times may be appealed to as evidence as well that the study of laws is the proper exercise of the intellectual faculty, as that the knowledge of them is attainable. Having given much attention to the investigation by mathematics of physical laws, I venture to express the opinion that there are no laws and operations of nature which may not become intelligible from our sensations and common experience; that they all resolve themselves ultimately into *pressure* and *inertia*, which we comprehend by *sensation*, and relations to *space* and *time*, which we understand by the experience of our present existence. This view

will, I think, eventually be established by means of the wonderful aid which is given to the reasoning faculty by calculation, the application of which was clearly designed by the Creator when He "ordered all things in measure, and number, and weight" (Wisdom xi. 20). Thus, after all, the indications of sense may be the foundations of knowledge. Who will pretend to say that *sound*, *harmony*, *light*, and *colour*, as perceived by the senses, are not eternal realities? St. Paul says (Eph. v. 13), "whatever is manifested is light," making no distinction between natural and spiritual light.

'But He who ordained the laws of nature for the purposes above mentioned, is not bound by them. Occasionally He supersedes them, when it is His will to make His *power* more effectually known. This is always done *significantly*, and with reference to *instruction* and *correction*, the manner and the circumstances of such acts having always an *esoteric* meaning. These acts are *miracles* to us, simply because they are exceptions to ordinary experience; but they are no more miraculous than any *creative* act. The *poet* creates, and by the intervention of writing can make his conceptions perceived by others. God alone can give *immediate* external effect to His thoughts and intents.' (Professor Challis's *Creation in Plan and in Progress*, pp. 121–3.)

SECTION VI.

ON THE DISTANCES AND MAGNITUDES OF THE FIXED STARS.

THE question as to the distances of the fixed stars is one that has an important bearing upon the scriptural account of the creation. It is a question, too, which has frequently been discussed in a very vague and unscientific manner, and conclusions have been reached which, though founded upon premises purely speculative and conjectural, have been not unfrequently referred to as among the well-established truths of astronomy. There is, perhaps, no science which offers so many temptations to indulge in speculation and conjecture as sidereal astronomy. The starry heavens present such splendour and magnificence to the eye, and the telescope reveals so much more than the eye alone can discern, or even the imagination conceive, that the mind of man has been irresistibly led to the solemn contemplation of the gorgeous scene from the earliest ages. Within the last hundred years, practical improve-

ments in the telescope, and the unremitting perseverance of observers, have given us a wonderful insight into the depths and sublimities of the stellar universe. In no department of inquiry has observation presented its fruits in such rich abundance; and with equal truth may it be affirmed, that in no department have well-ascertained phenomena been so difficult to trace to satisfactory causes, or so hard to group under certain and sufficient physical laws.

Whoever opens a modern book on sidereal astronomy, will find his eye delighted by the beautiful objects depicted, and his mind impressed with feelings of awe and reverence by the descriptive details of what the telescope has revealed. But, with comparatively few exceptions, he will seek in vain for any elaborate investigation of laws and principles analogous to those by which nearly all that concerns the solar system is explained and accounted for: — of the much that is *seen*, but little is *known*.

The distances, and magnitudes, and revolutions of the planets are all determinable upon the strictest scientific principles, with a degree of accuracy sufficient to satisfy all reasonable demands. The distances of the fixed stars we know, for certainty, only in a very few individual instances, and of their actual magnitudes we know *for certainty*, nothing.

In former times relative splendour in the fixed stars was regarded as indicative of relative magnitude, and they were accordingly classed as stars of the first, second, third, &c., magnitudes, upon this principle; and that classification it has not been thought necessary by modern astronomers to disturb; but with them the term always means magnitude of light, not of bulk. It was also generally supposed that the apparently larger and more brilliant of the fixed stars were less remote than the smaller, and fainter; and, in books, Sirius was frequently referred to as one of the nearest, if not the very nearest, of the fixed stars; but this error has been corrected. Sir John Herschel has found that the lustre of Sirius is four times that of α Centauri, yet Sirius is now known to be nearly four times the distance of α Centauri. The light from this latter star reaches the earth in about 3 years $6\frac{1}{2}$ months; but the light from Sirius is upwards of 14 years on its way, estimating the velocity of light at 192,000 miles in a second of time.

Till within the last thirty years astronomers had no strictly scientific means of determining the distance of any fixed star whatever. They were left to infer distance, whether of single stars or nebulæ, from the character, and intensity, or faintness of the light received from them, which, as seen from the above-mentioned instance, must

have been a very uncertain test. Judging thus from the quality and quantity of the light, Sir William Herschel ventured upon what he calls 'very coarse estimates' of the distances of certain nebulæ. These conjectures, which no astronomer of the present day regards as of any scientific value or authority, some writers have hastily affirmed to be well-ascertained truths. Thus, in a recent work, intended for the instruction of youth—and a work on the whole of considerable merit—we find the following statement:—

'Herschel tells us that the light of the most remote of the nebulæ discovered by his telescope, must have taken two millions of years to reach our globe;' and the writer then adds, 'As, however, it *has* done so, it must have existed two millions of years. But "at the beginning," when the *heavens* were created, this earth was created also, and therefore must have existed, according to this calculation, at least two millions of years.'

But the writer who draws this conclusion from Herschel's merely speculative opinion at a time when science furnished no accurate means of solving the problem of the stellar distances, cannot be aware that in Herschel's time, and for many years afterwards, the erroneous idea prevailed, that the stars which had been classed, on account

of their superior brilliancy, as of the first magnitude, were nearer to us than the apparently smaller stars; a principle which is now known to have no foundation in fact. Even so late as the year 1833, in a scientific work on astronomy, by a very competent author, we find the following remarks in reference to this problem :—

'The very unequal magnitudes of the stars, and rapid increase of the numbers as the magnitudes decrease, afford a very strong presumption that their relative apparent magnitudes depend, in a great measure, on their comparative distances; and hence that the stars of the first magnitude are, *generally*, those which are nearest to our system. It is on this assumption, that the immense distances of the nebulæ have been estimated by the great astronomer (Sir W. Herschel), whom we have so frequently occasion to mention, and to whom alone we are indebted for nearly all our knowledge of the amazing extent of the universe, and of the arrangement of the starry hosts of heaven. On this supposition a scale of distances is formed; but it unfortunately happens that we do not know the value of the *first* degree of it: the distance of the nearest of the fixed stars is not yet ascertained. The whole subject is, therefore, one of hypothesis and probability — hypothesis, however, supported by all

that we *do* know that can supply analogy, and so far confirmed by concurrent phenomena, as to give it a very high degree of probability.' *

When the above was written (1833), the parallax of none of the fixed stars was definitely settled. But now the determination of this important element in the cases of a few of those which are the nearer to our system, has compelled the conclusion that no safe inference as to distance can be drawn from comparative splendour. It was well known long ago, that if the annual parallax, as it is called, of any fixed star could be correctly ascertained, the actual distance of that star might be computed with the greatest ease and certainty. The ardour of modern observers, combined with the great improvements in the instruments of observation, have, within the last twenty or thirty years, led to a satisfactory solution of the problem of parallax, the amount of annual parallax having been ascertained, and the distance accordingly determined of some few of the nearer stars.

As to the meaning of the term, annual parallax, it is easily explained. Conceive two straight lines to be drawn from the star, one to each extremity of a diameter of the earth's orbit; then one-half

* *The Principles of Astronomy*, by William Brett, M.A., Fellow of Corpus Christi College, Cambridge, part ii. on 'Physical Astronomy,' p. 177. 1833.

of the angle formed at the star by these two lines measures the annual parallax, the radius of the orbit, namely, about 95 millions of miles, being the base of a right-angled triangle, of which the star is the vertex. The vast majority of the stars are so distant that this angle becomes too minute to be discoverable, the sides containing it not deviating in any sensible degree from two parallel lines. But although in every case exceedingly minute, the parallax has been measured in the following instances: —

STAR	PARALLAX	YEARS FOR LIGHT TO TRAVEL	OBSERVER
α Centauri	0·913	3·54217	Henderson
61 Cygni	0·348	9·29310	Bessel
ι Lyræ	0·261	12·39080	Struve
Sirius	0·230	14·06087	Henderson
1830, Groombridge	0·226	14·30973	
Ursæ Majoris	0·113	24·31579	
Arcturus	0·127	25·46456	Peters
Polaris	0·067	48·26866	
Capella	0·046	70·30435	

These determinations cannot be regarded, after all, as more than approximations, sufficiently close, however, in the greater number of the nine stars here selected, to transfer the statements as to their distances out of the region of pure conjecture into that of approximate certainty. The determinations with respect to Capella, as given above, are confessedly of no value, as M. Peters himself

regards the probable error in the parallax as greater even than the entire value which he obtains for its measure; for he estimates the probable error to be so great as 0″·2. And, generally, as may well be expected, the more minute the parallax of a star is, the greater is the probability of error in its determination. Yet it is to this determination alone that we must look for all the information, of any real value, that we can acquire as to the actual distances of the fixed stars. Inferences drawn from their comparative lustre, or from the amount of light received from them, are little more than ingenious guesses. We do not know that *all* the light reaches us. We do not know that the stars are all of the same intrinsic brilliancy. It may be TRUE, that 'one star differeth from another star in glory,' and if so, all the deductions from the photometry of the stars must be utterly valueless.

'There are two grave uncertainties attaching to the employment of such modes of estimation. *First*, if we would infer distance from magnitude, it is necessary that we have a correct photometry of the stars. Unfortunately, this important department of practical astronomy remains in a condition very far from satisfactory. At present there is no fixed or universal scale; and the same observer frequently varies in interpreting his own scale. *Secondly*, an objection very much more grave is

also alleged to apply. Are we authorised to assert that the whole light emitted by a star reaches the earth? In other words, is not part of that light extinguished or absorbed as it traverses the interstellar spaces? If absorption of this kind takes place, our inference as to distance, on the ground of mere apparent magnitude, would evidently err by excess, for the stars must be comparatively near us. The fact of such absorption was first asserted by Olbers, on grounds which we cannot at present dismiss as insufficient. If there be no absorption, these bodies should all shine with the same *intrinsic brightness*, whatever their distance, *i. e.* although distance would diminish the *quantity* of light they transmit, it would not affect its *quality*. But the smaller stars are *duller*: their light fades through effect of an increasing deadness. How is this to be accounted for? Not by absorption in our atmosphere merely; hence, said Olbers, the likelihood of an interplanetary ether and of *extinction* in some proportion to the distance of the star.' * Taking, then, the only sound scientific method of computing the stellar distances, namely, the method of parallax, we may confidently affirm that there is no object in the sidereal heavens, whether it be fixed star or nebula, the light from which can be safely affirmed to take even so long

* Nichol's *Cyclopædia of the Physical Sciences*. Art. 'Stars.'

as two hundred, much less two millions of years in arriving at this earth. If any object actually exists the light from which would occupy two hundred years in reaching us, no astronomer could ever become acquainted with the fact, inasmuch as the annual parallax of such object would be far too minute to be detected by all the resources of modern science.

If matters of moment out of astronomy, and higher than astronomy, become unsettled and disturbed by astronomical speculations, it is of consequence that such speculations should be brought to the test of reliable observation and calculation, and estimated accordingly at their real value. Not that speculation in physical inquiries should be discouraged—it is often the precursor of scientific truth — but till thus confirmed, it must be regarded as matter of individual opinion, and nothing more. The indefatigable Sir William Herschel stands at the head of astronomical observers; he revealed to us more of the starry heavens than any other man either before or since; but he indulged largely in magnificent theories, several of which the enlightened zeal of his successors have proved to be almost prophetic anticipations of what they have ascertained to be truths. But in some he was less successful, and in none more so than in his estimation of the *distances* of the gorgeous objects which his

powerful telescopes were the first to disclose to the human eye. His illustrious son has himself adverted to this mode of estimation. The space-penetrating power of the reflecting telescope used by Sir W. Herschel in most of these researches was a power of seventy-five; that is, when directed to a star of any given brightness, it would augment its brightness so as to make the star appear as it would do if at seventy-five times less distance. In other words, a star seen by the naked eye to have a certain degree of brilliancy, would be seen by the telescope to have the same degree of brilliancy, though removed to seventy-five times its actual distance. Thus: 'A star of the sixth magnitude removed seventy-five times its distance would still be perceptible *as a star* with that instrument;* and admitting such a star to have one-hundredth part of the light of a standard star of the first magnitude, it will follow that such a standard star, if it were removed to 750 times its distance, would excite in the eye, when viewed through the gauging telescope, the same impression as a star of the sixth magnitude does to the naked eye. Among the infinite multitude of such stars in the remoter regions of the galaxy, it is but fair to conclude that innumerable individuals, equal in intrinsic brightness to those which immediately

* Stars of the sixth magnitude are but just perceptible by the naked eye to persons of ordinary visual powers.

surround us, must exist. The light of such stars must, then, have occupied two thousand years in travelling over the distance which separates them from our own system.' *

Interesting and ingenious as this reasoning is, no one better than Sir John Herschel knows that the quantity of light received from a star is but an uncertain test of distance. Even if the quality of all star-light be regarded as uniform, as in all these speculations is actually done — yet size has much to do in determining quantity. From an experimental examination, Sir J. Herschel himself arrived at the conclusion that the light from Sirius is four times that from α Centauri, and yet the more brilliant star is now *known* to be nearly four times as remote as the fainter one. In like manner, 61 Cygni, a small star barely of the fifth magnitude, is but little more than one-third of the distance of the large and bright star Arcturus, of the first magnitude.†

Since the determination of parallax has made known to us these facts, the discrepancies in the conclusions deduced from the photometry of the stars have been removed, upon the hypothesis that the superior brilliancy of stars, thus unexpectedly

* Herschel's *Outlines of Astronomy*, p. 541.

† 61 Cygni is usually regarded as a star of the *sixth* magnitude, but strictly it is between the fifth and sixth, a little nearer the latter.

found to be more remote than much fainter ones, must arise from their superior bulk; and on this principle it has been computed that α Centauri has more than twice the superficial magnitude of our sun, and that Sirius has more than 146 times the superficial magnitude of the sun; so that the diameter of Sirius is made to be 10,663,380 miles.

With all respect and reverence for the name of Herschel, we submit that there are but very feeble grounds for these conclusions. Reliable observation has shown that 'the stars which immediately surround us' are *not* the brightest stars: of those whose parallax has been ascertained, the faintest are in general the nearest. No doubt, as Sir John Herschel states, there are numerous individual stars in the remoter regions, which, if brought nearer, would shine with the brightness of stars of the first magnitude; but *how much nearer* can only be conjectured, since we know not how much of the light from the remote star fails to reach the eye. Without any such extinction of light, the space-penetrating power of the elder Herschel's forty-feet telescope is estimated at 2,080; but the celebrated Struve, making what he considers to be due allowance for extinction, reduces the range to 368—an enormous reduction of distance.

But, as before stated, the only trustworthy

estimation of distance is that deduced from the observed parallax of the star, so that if the object be too remote for the parallax to be sensible, we shall never know its distance with any degree of certainty. For a parallax of one second the distance would be 19,595,000,000,000 miles, that is, nearly *twenty billions of miles*; and as no fixed star hitherto observed has so great a parallax as this, we may reasonably conclude that, whatever may be the remoteness of individual stars, all of them are at a greater distance from our system than the above number of miles expresses. And to traverse even this space, light takes three years and eighty-five days. We have seen that in the case of α Centauri, the nearest of the fixed stars, in so far as we know, the light occupies three years and one hundred and ninety-eight days in traversing the distance between it and us.

The reader will be careful to notice that the conclusions as to the stellar distances deduced from parallax are the strict results of actual angular measurement, taken with the most perfect instruments employed for the express purpose by the most able and experienced observers, combined with accurate calculation with the data thus furnished; so that these conclusions cannot possibly be affected with any error except what must unavoidably attach to human constructions, however carefully elaborated, and to human powers in using

them. No hypotheses are assumed, no conjectures indulged: the result is wholly deduced from actual observation, which every competent observer may repeat and verify.*

But with the other method of deduction the case is very different. It is based on the *supposition* that the stars, in general, have the same intrinsic brightness; 'and we accordingly consider the stars to derive their variety of lustre almost entirely from their places in the universe being at various distances from us.'†

This general uniformity of intrinsic brightness is further supposed to be that of our own sun, which, in all these stellar inquiries, is conceived to be the model or pattern pretty generally followed in the construction of the stars. Now, we submit that the reasons against such a supposition greatly outweigh the reasons for it. Our

* We believe that the parallaxes of α Centauri and 61 Cygni are those which astronomers regard as having been determined with the greatest accuracy. That of the former star was found by Mr. Henderson, at the observatory under his direction at the Cape of Good Hope, and the observations were repeated and verified by his successor, Mr. Maclear. The parallax of 61 Cygni was determined by the celebrated Bessel, with the great Konigsberg Heliometer, constructed by Frauenhofer; the measures were taken on every available opportunity throughout one year, and they were repeated during another year, and the two sets of measures agreed in their results. The same results were afterwards obtained by M. Peters, and subsequently confirmed, with the Heliometer at Oxford, by Professor Manuel Johnson.

† 'The Stellar Universe:' Lardner's *Museum of Science.*

speculations about what we *do not* know, are the more likely to be true, the less inconsistent they are with our *convictions* about what we *do* know. And in contemplating nature, nothing strikes us more than the endless *variety* which she presents. The leaves of the forest are probably as numerous as the stars of heaven, and yet it is very unlikely that any two, even, are precisely similar, either in figure or in tint. It is the same with the flowers of the field: a bed of pansies or of tulips will neither of them furnish more than two or three, if any, specimens precisely alike in richness of colour, in size, or even in shape. Take, too, the human form: where shall we find two persons the one the exact counterpart of the other, or even two countenances? With such indisputable facts around us, how can we venture to affirm, without palpable inconsistency, that all the millions of suns in the sidereal heavens—if suns they really be — are facsimiles of the only *one* sun that we *know* anything about?

But, waiving all these considerations, suppose it to be *true* that the light from those remote nebulæ discovered by Sir William Herschel, and recently resolved into clusters of distinct stars by the great telescope of Lord Rosse — suppose the light from these to have reached us only after the lapse of millions of years: let us inquire how the supposition affects the Mosaic Cosmogony.

At page 112, we noticed the peculiar way in which the creation of the stars is parenthetically mentioned in Genesis, nothing being definitely stated as to the epoch of that creation. In the brief comments there ventured upon, in reference to this circumstance, we had a prospective view to the remarks we are now about to offer.

As Moses is altogether silent on the subject, we conjectured, at the page referred to, that the fixed stars were placed in the firmament on the second day; but if the stars are any of them as remote as is here supposed, *they* could not have been placed in this firmament at all; since they must have existed myriads of ages before the ethereal matter so called was made. On this supposition, the immensely more remote firmament of these stars must, with those stars themselves, have had *invisible* existence long prior to the Adamite epoch, with which alone Moses is concerned. We say, *invisible* existence, because the firmament introduced on the second day must then have been exclusively the planetary firmament; and as, previously to this introduction, there could have been no ethereal communication between the stars and the earth, light could not pass the void, and reach our planet: all above and around would have been as complete darkness as if no star existed. Such invisible material existences it could hardly be

expected that Moses should dilate upon, more especially as they were things not comprehended in the works of the six days, and the light from which would be at least three years in crossing the ethereal path which the firmament had now made for it to proceed along. The apparently unsatisfactory way in which 'the stars also' are mentioned, shows, in reality, a wise reservation. Astronomy, or fancy, is left free to place them where it pleases; Moses cares only to tell us that they 'also' were made by God.

The conclusion is this: if the stars are *not* so immensely distant as here supposed, and were comprehended in the works of the six days, then the firmament made on the second day extended to the *remotest* sidereal object at least. But—

If the stars *are* as remote as here supposed, then they were *not* comprehended in the six days' work (and Moses does not say that they were), and the firmament made on the second day extended only to the *nearest* of those stars, uniting with the distant firmament already existing. In this intermediate region of ether the sun, moon, and *wandering* stars, or planets, were placed; and the whole ethereal region, thus enlarged, is that which, in other parts of scripture, is comprehended under the general designation of *firmament*, and comprises what we have ventured to regard as the second heaven. There is thus

not the slightest discrepancy between the Mosaic narrative and astronomical conclusions respecting the creation of the fixed stars. That narrative is wholly unaffected by such conclusions, and remains entirely unimpugned, whether the stars and nebulæ, any or all of them, were created six thousand years ago, or six millions, or at any other time whatever, however remote. The chronology of the sun and moon, and of the region they were to occupy, is given by the inspired writer with circumstantial precision; but of the stars nothing is recorded but that He made them. And there seems to us to be much far-seeing wisdom and significance in the *omission* of every revelation respecting 'the stars also.'

In the section on the Mosaic Cosmogony, we reasoned on the hypothesis that the fixed stars were introduced on the second day of the creative week. At present, hypothesis, as to the age of the stars, is all that is left to us. Scripture is silent on the subject, and science is equally silent. Let the latter determine hereafter, as it may, the Divine record will remain completely unaffected by the determination. Science may, perhaps, in future time enable us to elucidate the doubtful point as to whether the fixed stars were created during the six days, or whether at an epoch long anterior, and to science the matter is wholly and most wisely left.

It remains now that we say something as to the supposed *masses* of the stars. These, in certain individual cases, have been inferred from those double stars constituting what are called *binary systems*, which consist of two stars revolving round each other. The star α Centauri is a double star of this kind, and so is 61 Cygni; and some hundreds of similar systems have been observed, and the periods of revolution of many of them have been determined with tolerable accuracy.

'The moment the revolution of one star round another was ascertained, the idea of the possible extension of the great principle of gravitation to these remote regions of the universe naturally suggested itself. Newton has proved, in his *Principia*, that if a body revolve in an ellipse by an attractive force directed to the focus, that force will vary according to the law which characterises gravitation. Thus an elliptical orbit became a *test* of the presence and sway of the law of gravitation. If, then, it could be ascertained that the orbits of the double stars were ellipses, we should at once arrive at the fact, that the law, of which the discovery conferred such celebrity on the name of Newton, is not confined to the solar system, but prevails throughout the universe.' *

In these remarks we cannot quite concur. The

* 'The Stellar Universe:' Lardner's *Museum of Science.*

revolution of one body round another in an elliptic orbit does certainly seem to imply a physical connection between the two analogous to that which prevails in our own system. The *law* may be the same; but is its *intensity* the same? The law alone suffices to account for the observed elliptic motion; but, knowing the mass, we can never infer the force of its attraction at a given distance from it without actual experiment, nor, knowing the force at a given distance, can we infer the mass of the attracting body. If we *assume* that the force of attraction among the stars implies the same mass of body in the stellar universe that it implies here at home, we can determine the mass of a pair of revolving stars. But what authority have we for such an assumption? We are acquainted with the connection between mass and gravitating force in just *one* system: are we from this single case to infer that the same connection exists in every other system throughout the universe? Are we in science to be guided by the precept, *Ex uno disce omnes?* Can any authority be assigned beyond the authority of this maxim for the assumption, that in remote regions of the universe, with which we have no physical connection, a mass not a tenth or a hundredth part of the mass of the earth *cannot* be endowed with all the attractive power the earth itself has?

The period of revolution of the binary system α Centauri is 77 of our years; the period of revolution of 61 Cygni is about 540 years; and the masses are determined precisely upon the same principles as the mass of Jupiter is determined from the periods of revolution of its satellites — not only the law of force, but the intensity of the force being presumed to be the same, for the same mass and distance, as it is in our system.

But there is no *necessary* connection between quantity of matter and intensity of attracting force. The Newtonian *law*, as to the variation of this force, according to the inverse square of the distance, may, and probably does prevail, beyond the boundaries of our system; but we have no right to assume that because mass and force are related in a particular way *here*, the relation must be the same with all the myriads of systems in the universe. Newton himself could not have thought thus, for he hesitated to assert that any attraction at all was essential to matter. He says, 'I by no means affirm that gravity is essential to bodies.'*

Much has been said of late about the immutability and universality of physical laws; but of this universality we know little or nothing beyond the limits of the system in which we are placed; and of their operation here even we have much

* *Principia*, Book iii.

yet to learn. In reference to a certain *spiral nebula*, Lord Rosse observes, that 'with each increase of optical power, the structure of this object becomes more complicated, and more unlike anything which could be supposed to be the result of any form of dynamical law of which we find a counterpart in our system.' In *this* system, however, the dynamical laws imparted to it by the Creator are such, that the movements resulting from them must go on, age after age, with undeviating regularity, so long as His Power is not specially put forth to arrest them.* Omnipotent intervention is not required to sustain them. But how different may it not be in the starry universe! Who can say that even the Divine Mind is not exercised *there* in a manner remotely analogous to that in which the human mind, His feeble 'image,' is exercised here? How do we know that those wondrous movements, which so puzzle and perplex the great intellects of this remote planet, obey any physical laws even in any respect similar to those which operate here; or, in fact, that, strictly speaking, they obey any *physical* laws at all? As the starry universe was brought into existence without any physical agency, how do we know that, in the main, it is not sustained, and all its mysterious movements governed and regulated

* Or, more strictly, so long as no *external* cause interferes. (See p. 228.)

solely by the Creator's mandate, and that His direct WILL is the only law they submit to?

Indeed, it is scarcely reasonable to suppose that, after the six days' works, the last of His creative acts, the Deity retired, as it were, from all personal superintendence and control over even a single region of the material universe, leaving every part of His vast creation to the guidance and governance of physical laws, impressed once for all. The fixed stars, as they are called, have *proper motions*, for which science cannot satisfactorily account. Many of them vary in splendour and in apparent magnitude from time to time. There is a star in the Head of Medusa (Algol), which passes through continuous changes, from a star of the second magnitude to one of the fourth, and then increases again to the second magnitude, all within a less space of time than three days. There *appears* to be law here, but what it is we can only conjecture. In the years 1840, 1841, Sir John Herschel found the star β of the Little Bear much brighter than the Pole star, whereas at a former period the direct contrary was the case. The stars, too, present not only great varieties as to brilliancy, but also as to colour, even individual stars passing from one colour to another. Sirius was formerly described as 'fiery red,' it is now perfectly white. Procyon, the Pole star, and β of the Little Bear, are *yellow*;

Betelgeux, Arcturus, Aldebaran, &c., are *red*; some are ruby-coloured, some blue, and some green. How are these mysterious phenomena to be accounted for upon any physical principles known to man? Then, again, there are the multiple stars furnishing examples of two and three or more *self-luminous* bodies revolving round one another. *Here* the central body alone is self-luminous, the bodies which revolve round it being all opaque; whereas we do not know if there be even a single case of this kind among the worlds above. These, and many other striking departures from the physical economy of our own system, should make us hesitate to assume an exact similarity in anything. The stars *may be* bodies like to our sun, and have planets of their own revolving round them, or they may not. Some stars *may be* of immensely greater mass than our sun, and others may be considerably less. But it is too much to say, as a recent writer has said, that 'Our earth is but one of the lesser pendants of a body [the sun] which is itself only an inconsiderable unit in the vast creation;'* for anything that science can prove to the contrary, the sun, as to mass, *may be* the most considerable unit in the universe.

For aught that we *know*, the material of the fixed stars may be unsolid luminous matter, like

* *Essays and Reviews*, p. 213.

the photosphere of our own sun — the alone source of our light and heat. A solid nucleus has never been detected in a single one, and the most powerful telescopes reveal them to us as only masses of light. If they are more than this, science is ignorant of the fact.

But whatever be the constitution of the stars, we know that our system is removed (as yet) from even the nearest of them, to such an immense distance that our physical laws cannot affect them, nor theirs (if such laws they have) us. But towards some of them we are moving; our whole system is advancing bodily towards a particular quarter of the starry regions. Astronomers consider its motion to be describing some vast orbit round a centre situated in the group of the Pleiades; and the celebrated Maedler computes the period of its revolution to be 19,256,000 years!

These conclusions, however, must be received with a degree of reserve proportionate to the uncertainty in the data from which they are derived. As to the actual movement of our system towards the starry regions, there is no uncertainty whatever: it is advancing onwards at a rapid rate.* Long before the above-mentioned vast period is completed, it may be sufficiently near to some of the fixed stars to bring them

* Upwards of four hundred thousand miles a day.

within the sphere of its attraction. If so, what will be the consequence? The scripture clearly points to a final catastrophe of this kind: 'And the stars of heaven shall fall.'* If this prediction were not in the Bible, the ascertained truths of astronomy would justify our regarding such an event as not improbable; but as it *is* there, there may be some who, on that very account, may resist even the evidence which *science* furnishes in favour of such an occurrence. That it is physically impossible, no competent astronomer, whatever be his private bias or prejudice in other matters, will venture to assert. By the other class of persons we may, perhaps, be blamed for adverting here to such an anticipated consummation. But the task we have undertaken must be borne in mind. And before concluding it, we feel it to be our duty, even in such a case as this, to prove SCIENCE ELUCIDATIVE OF SCRIPTURE.

* Mark xiii. 25.

NOTE I. (p. 47).

Abstract of a Paper entitled, 'Researches in Physical Geology.' By William Hopkins, Esq., M.A., F.R.S.

IN a paper formerly read to the Royal Society, the author had investigated an analytical expression for the precession of the pole of the earth, on the hypothesis of the earth's being composed of a heterogeneous solid shell, inclosing a heterogeneous fluid, and showed that its amount, deduced from that hypothesis, could not agree with its actual observed amount, unless the ellipticity of the interior surface of the shell were less by a certain quantity than that of the exterior surface. As the ellipticity of the inner surface (assuming always that the earth was originally fluid) depends on the thickness of the shell, the author, in the present paper, determines the least thickness which can be deemed compatible with the observed amount of precession.

In his former communication the author had contemplated only the case in which the transition from the solidity of the shell to the fluidity

of the mass contained in it was immediate; but in the case of the earth, it must be gradual and continuous. It is remarked, however, that if, in the actual case, we were to consider all that portion of the mass as solid which is not perfectly fluid, we should take the thickness of the shell too great; and, on the other hand, if we were to consider the whole of that as perfectly fluid which is not perfectly solid, we should take the thickness of the shell too small. There must, consequently, be some surface of equal fluidity (or, if we please, of equal solidity), such that if all above it were perfectly solid, and all beneath it perfectly fluid, the precession would be the same as in the case in which the transition from the solidity of the shell to the fluidity of the interior mass is continuous. This surface is termed by the author the *effective inner surface*, and the distance between this surface and the outer one the *effective thickness* of the shell.

The degree of solidity or fluidity at any point in the interior of the earth, must depend partly on the temperature at that point, and may also depend partly on the pressure there. Both causes are here assumed to be effective. If the latter be not so, it will easily be seen that the conclusions arrived at will, *à fortiori*, be true.

If, through any point in the interior of the earth (as, for instance, a point in the axis of

rotation), we take a surface of equal temperature, and, through the same point, a surface of equal pressure, it is evident that the surface of equal fluidity (or solidity) through that point must be intermediate to these two surfaces. Its exact position cannot be determined without an experimental knowledge, which we do not possess, of the relative effects of temperature in opposing, and of pressure in promoting, the process of solidification. It is sufficient, however, for the purpose now in view, to know that it must necessarily lie between the surfaces of equal temperature and of equal pressure as its extreme limits, and of these the author proceeds to determine the positions.

The forms of the isothermal surfaces within a spheroid have never been completely determined. The determination given by the author is an extremely approximate one when the ellipticity is small, and the time during which the process of cooling has been going on is very great, as it is presumed to be in the case of the earth.

The author then enters into the analytical investigation of this problem, and deduces the conclusion, that we must descend to a depth greater than about one-fifth of the earth's radius, before we arrive at a surface of equal fluidity (or solidity) having an ellipticity of the requisite value; that is, the effective thickness of the crust must be at least equal to one-fourth or one-fifth

of the earth's radius, in order that the precession may have its observed value — a conclusion, the author observes, which entirely removes the foundation of certain vague and somewhat fanciful speculations in geology, proceeding on the hypothesis of the thickness of the earth's crust not being greater than twenty or thirty miles.

It has been imagined, that in active volcanoes the volcanic vent may communicate directly with the central fluid nucleus, whence the ejected fluid mass has been supposed to be derived. This notion, the author conceives, is rendered totally inadmissible, when it is proved that the thickness of the solid portion of the globe cannot be less than 800 or 1,000 miles.

It is also remarked, that it follows from the great thickness of the crust, that the present interior temperature of the earth cannot be due to its original heat, unless pressure be effective in promoting solidification, a fact not yet established by experiment; for if the present temperature be due to that cause, it is certain that it must be sufficient, at the depth of probably less than fifty miles, to reduce the matter composing the crust of the globe to a state of fusion, under the atmospheric pressure; whereas it has been proved that the earth is solid to a very much greater depth, which can be accounted for, therefore, only by supposing its solidity to be preserved

by the enormous pressure to which, at considerable depths, the mass is subjected. The author then offers an explanation of the phenomena of volcanoes, on the supposition that a portion of matter more fusible than the general mass of the globe exists in a state of fusion in subterranean reservoirs, forming so many subterranean lakes of determinate extent, in some cases originally distinct, in others communicating with adjoining lakes, by more or less obstructed channels, a theory which will also account for all the obscure geological elevations, except, perhaps, the earliest, as being produced by a simultaneous action of a fluid pressure on every portion of the lower part of a solid mass of definite extent. The author considers this harmony in his general views, with the results of analytical investigation, as constituting for them a strong claim to the attention of geologists.

Another important conclusion which the author deduces from his researches is, that if the interior temperature of the earth be due to its primitive heat, pressure must be effective in promoting solidification of masses at high temperatures. (From *Abstracts of the Papers printed in the Philosophical Transactions*, 1837–43.)

NOTE II.

Proof of the Two Propositions at p. 167.

THE following NOTE, furnishing the mathematical proof of the two propositions announced at p. 167, is extracted, with but slight alteration, from the author's treatise on ALGEBRA.

Let us suppose that a person comes voluntarily forward, and testifies to the fact that he had been eye-witness to the performance of a miracle; that on being required to state explicitly *what* miracle, he averred that he had seen a dead man raised to life. Suppose, moreover, that ten other persons, with every desire to deceive, but without collusion, come forward, and declare individually that *they* also had witnessed *the same* miracle. And let us further suppose that these ten abandoned persons were limited within the very narrow range of only ten fabrications equally suitable to their purposes of deception: the probability that they would all fix upon the particular miracle mentioned is $\frac{1}{(10)^{10}} = \frac{1}{10000000000}$.

If instead of ten persons there were twelve, the probability would be $\frac{1}{1000000000000}$, that is, the

odds against the occurrence of this supposed uniformity of testimony is within a unit of a *million millions* to *one*, on the supposition that the pretended miracle is a fabrication. This conclusion is incontrovertible; and, like the other deductions from the theory of probabilities, will be found in strict accordance with the suggestions of common sense. If a notorious liar meet us in the street, and inform us that a murder has just been committed at a certain place, we give little or no credence to his statement; but if another person equally void of integrity, and who, we know, cannot have communicated with the former, tell us the same story, we cannot resist a strong impression in favour of its truth, —we place no value upon the veracity of our informants, but a very high one upon the improbability of two fabricators of falsehoods independently inventing the same precise falsehood at the same time.* If a third person of like character repeat to us the information, we place as much reliance on the truth of the statement as if it had been made by a person of unquestionable veracity. The evidence of bad characters is some-

* As Mr. De Morgan justly remarks, in reference to cases of this kind, 'Whether they be good or bad witnesses individually can only affect the rational probability of their assertion, in the manner in which it affects our disposition to suspect combination.' *Encyclopædia Metropolitana*, Art. 'Probabilities.'

times rejected in courts of justice, on the ground that they are not to be believed on oath: yet if several of these bear independent testimony to the same event out of a number of other events equally likely to suggest themselves, or to have occurred, we see that a high degree of probability would attach to the statement.

The foregoing conclusion, respecting the concurrent testimony of thirteen witnesses, has an obvious bearing upon Hume's celebrated argument on miracles, in which he attempts to prove that no amount of human testimony in favour of a miracle can ever render its occurrence so highly probable, as the uniform experience of mankind against it renders it improbable.

This uniform experience of the whole human race since the creation in favour of the non-occurrence of a miracle, on the highest computation, is about two hundred thousand millions to one. We have seen above, that if only thirteen individuals bear independent testimony to the fact, even supposing that they have only ten other events to choose from, the probability that that fact is not a fabrication is a million millions to one, a probability *five times* the former.

The point mainly insisted upon in Hume's argument is the fallibility of human testimony, which, either from want of integrity in the witnesses, or want of sagacity to detect fraud, has

often deceived us, while 'the laws of nature' never have. The considerations offered above are altogether independent of the character of the witnesses, and remain unaffected by every hypothesis as to their honesty or their intellect.

Let us now briefly inquire into the probability in support of a *specified* miracle, in reference to which alone the testimony of persons affirming themselves to be eye-witnesses is to be received, deriving our conclusions from the combined considerations of the probability of the testimony, and the inherent improbability of the miracle. Here all depends upon the number and integrity of the witnesses: let the probability of falsehood be p for each, their number being n; collusion is of course, as before, out of the question.

Let m be the number of persons who have certainly died without resurrection out of $m+1$ persons, the entire number brought into existence since the creation, so that out of these $m+1$ persons the event cannot possibly have happened more than once; all the ways of happening and failing are therefore $m+2$: hence the probability of happening is $\frac{1}{m+2}$, and therefore the probability of not happening is $\frac{m+1}{m+2}$. Also the probability that the witnesses agree in speaking the truth is $(1-p)^n$, and that they concur in false-

hood the probability is p^n. For the probability of the happening of the event — as inferred from the whole of the evidence — we must divide the result of the hypotheses favourable to the happening by the sum of the results of both hypotheses, favourable and unfavourable: we thus have for the probability of the witnesses speaking truth, and of the event having occurred,

$$\frac{(1-p)^n \frac{1}{m+2}}{(1-p)^n \frac{1}{m+2} + p^n \frac{m+1}{m+2}} = \frac{(1-p)^n}{(1-p)^n + p^n (m+1)};$$

and for the probability of the contrary, or the improbability of the event,

$$\frac{p^n (m+1)}{(1-p)^n + p^n (m+1)}.*$$

In order, therefore, that the inherent improbability of the event, when combined with the neutralizing force of the testimony, may render that event, all circumstances considered, more probable than improbable, we must have

$$(1-p)^n > p^n (m+1) \text{ or } (\frac{1}{p}-1)^n > (m+1);$$

$$\therefore n \log (\frac{1}{p}-1) > \log (m+1) \therefore n > \frac{\log (m+1)}{\log (\frac{1}{p}-1)}.$$

* These are the expressions used by Mr. Babbage, from whom the line of argument in the present article is taken. But in what follows from this point, the reasoning and ultimate conclusion are different. (See Babbage's *Ninth Bridgewater Treatise.*)

Let $m+1$, or the number of persons since the creation, be a million millions: let also each witness tell one falsehood for every nine truths; that is, let $\frac{1}{p}=10$, then

$$n>\frac{\log 10^{12}}{\log 9}>\frac{12}{\cdot 954}>12.$$

Consequently, any number of witnesses greater than 12, whose veracity is such that they tell only one falsehood to nine truths, testifying to the truth of an event, the improbability of whose occurrence is a million millions to one, renders that event more likely to have happened than not. But on the highest computation, as to the number of the human race since the creation, a million millions is five times the reality: hence, as before, the probability *for* the event is *five times* the probability against it.

THE END.

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